

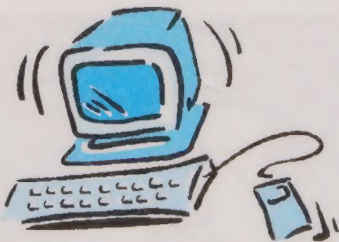
PLASTIC SURGERY, ITS PRINCIPLES AND PRACTICE

DAVIS, JOHN STAIGE, 1872-



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WELSH SURGERY

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PLASTIC SURGERY

DAVIS

PLASTIC SURGERY

ITS PRINCIPLES AND PRACTICE

BY

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THE AMERICAN SURGICAL ASSOCIATION; THE
SOUTHERN SURGICAL ASSOCIATION; ETC.

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To

K. B. D.

WHOSE GOOD COUNSEL AND NEVER FAILING
ENCOURAGEMENT HAS MEANT SO MUCH
TO ME IN THE UPS AND DOWNS OF LIFE.

PREFACE

About ten years ago my friend Dr. J. M. T. Finney, who knew of my interest in plastic surgery, suggested that I specialize in this work. He said that every general surgeon was operating on these cases because they had to be taken care of, but that no one in this country was doing the work properly and that the field was undeveloped.

As a result this book has been written to record my personal experience and also to collect from scattered sources, and place in an accessible form the principles and methods that have been of use to me.

It is my hope that this book may show the general practitioner the possibilities of plastic surgery, and start the student or beginner in this subject on the right track. The more experienced surgeon may also find methods with which he is unfamiliar, and which may be of use to him in dealing with plastic cases.

The teaching of this subject has been absolutely neglected everywhere, both for medical students and for post-graduates. There is as yet no department for instruction of this kind in any American University, and no complete text-book has hitherto been written on the subject.

It has been commonly said that any surgeon who can successfully do an intestinal suture can do plastic surgery. Careful investigation of this point warrants the statement—without qualification—that few general surgeons do plastic surgery as it should be done. The possibilities are little understood by the practising physician, and hardly more by the general surgeon.

The time has come for the separation of plastic surgery from the general surgical tree. There should be a well-trained plastic surgeon on the staff of every large general hospital, in order that these patients may be cared for intelligently.

During the war (1914-1918) plastic surgery was arbitrarily limited, by regulation, to maxillo-facial reconstruction. This, it is true, is a very important part of the subject, but it must be remembered—and the fact should be emphasized—that plastic surgery of the trunk and extremities is equally important. The results may be less spectacular, but surely are just as vital to the patient. The field of plastic surgery extends from the top of the head to the sole of the foot, and no properly

trained plastic surgeon would be willing to limit his work to the face alone.

Except for the progress made in the treatment of recent wounds of the face (especially those associated with fractures and loss of substance of the jaws—which are seldom if ever referred to the plastic surgeon in civil practice) little or no advance has been made in plastic methods during the war. The true plastic problems are much the same as those which must be solved in civil practice, although they may be new to the surgeon hitherto unfamiliar with plastic methods.

The list of publications, selected from those consulted, found at the end of each chapter will supply a good working basis for the reader who wishes to delve more deeply into that particular subject. When the same author has been quoted in more than one chapter, repetition of the reference has been avoided as far as possible, but the source of information may be obtained by consulting the bibliographical index.

Many of the illustrations have been taken from my own collection; others (most of which are diagrammatic) have been selected from various sources to demonstrate some condition, definite point, or method, and are self-explanatory.

I have made every effort to give due credit to all those whose writings or diagrams have been of use to me in the preparation of this work; any omissions are unintentional.

Should certain critics feel that I have encroached upon other branches of surgery in some of the subjects considered, a study of the text of these chapters will, I think, modify this opinion.

In the preparation of the book I have drawn with considerable freedom from the following: "La Rhinoplastie," Nélaton and Ombrédanne, 1904; "Les Autoplasties," Nélaton and Ombrédanne, 1907; "La Chirurgie Réparative de la Face," Depage, 1905; Plastic Surgery, J. S. Stone, in Bryant and Buck's "American Practice of Surgery," iv, 610; "A System of Ophthalmic Operations," Wood, 1911; "Ophthalmic Surgery." Beard; the numerous articles of the brilliant French plastic surgeon, H. Morestin, and many other sources.

I wish to express my thanks to friends who have referred interesting plastic cases to me; to Dr. W. S. Halsted, for permission to use material, much of which has come under my care, from the surgical clinic of the Johns Hopkins Hospital; to Dr. Frank R. Smith, for his help in supervising the manuscript; to Dr. I. W. Nachlas, for tabulating the cases of harelip and cleft palate at the Johns Hopkins Hospital; to my secretary, Miss Johnetta Moore, for her intelligent coöperation and tireless work

in the preparation of this book; to Miss Minnie W. Blogg, the librarian at the Johns Hopkins Hospital, and Miss Marcia C. Noyes, the librarian of the Medical and Chirurgical Faculty of Maryland, for their unfailing courtesy in making possible the examination of the large number of references consulted; and to the publishers, who have coöperated with me in every way possible.

If this book should prove of use in bringing relief to any one of our wounded soldiers who require the aid of the plastic surgeon, I shall feel fully repaid for the time spent in its preparation.

JOHN STAIGE DAVIS.

1200 CATHEDRAL ST.,
BALTIMORE, MD.
JULY, 1919.

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PLASTIC SURGERY

CHAPTER I

HISTORICAL REVIEW

THE DEVELOPMENT OF RHINOPLASTIC AND OTHER PLASTIC OPERATIONS

The history of plastic surgery is closely associated with the development of rhinoplastic operations, and nearly all of the procedures used have originally been employed in the process of this development. Many years before plastic surgery was attempted in Europe, certain members of the Tilemaker caste in India obtained wonderful results in plastic operations with pedunculated flaps from the cheek and later from the forehead, in the reconstruction of amputated noses. This is known as the *Indian Method*.

They are also said to have occasionally used successfully for the same purpose free flaps of skin taken from the gluteal region including the subcutaneous fat, after it had been beaten with wooden slippers until a considerable amount of swelling had taken place. They used a secret cement for the adhesion, to which was ascribed special healing power. This is called the *Ancient Indian Method*.

Here, then, is the earliest record of whole-thickness grafting, and antedates by centuries the work of Wolfe, Krause and others.

It is interesting to note that plastic surgery was practised in ancient India and Egypt, as is shown by the sacred writings of India, and in Ebers' Papyrus, in both of which rhinoplasty is mentioned as a well-known procedure.

Celsus speaks of the restoration of ears, noses and lips, with the aid of the neighboring skin, and Galen, Antyllus and Paul of Aegina also mention these operations.

Then for many years the art of plastic surgery seems to have been lost, at any rate to European surgeons.

In the middle of the fifteenth century, about 1442, Branca (or Brancas), a Sicilian surgeon, was able to build noses by taking pedunculated flaps from the skin of the face, and, following him, his son Anto-

nus is said to have restored a lost nose by using a flap from the arm. The first report of the employment of the arm flap in medical literature is a brief note found in a work on anatomy by Alexander Benedictus, published in Venice in 1497. Other surgeons of more or less repute were impressed with this work, and various allusions to the operation are to be found in surgical works of the sixteenth century.

The work of Gaspar Tagliacozzi (1546–1599) published in 1597, was the first systematic treatise on plastic surgery and was entitled “*De Curtorum Chirurgia per Insitionem*,” a volume of 298 pages including 22 full-page plates. In it he described several operations, but gives special prominence to his method of rhinoplasty, in which he used a pedunculated flap from the arm.

Two parallel incisions about 20. cm. long (8 inches) and 10. cm. apart (4 inches) were made down to the fascia on the anterior aspect of the left arm. The flap was separated from the fascia, and was kept away from its bed with oiled linen, but the pedicles at each end were not divided. After a fortnight when granulation and thickening had occurred, the upper pedicle was cut and the flap was sutured into the defect, after the edges had been revived. The arm was held in position by a special harness, and after three weeks the other pedicle was amputated from the arm, and the flap was shaped and fitted into the desired position. This is called the *Tagliacotian* or *Italian Method*.

The pupils of Tagliacozzi continued to carry out his method, but within a few years it was lost sight of, and in course of time began to be considered impossible.

Reneaulme de la Garanne (1712) tried to rehabilitate the method, and proposed sewing into the defect the fresh flap, immediately after raising it without waiting for it to granulate. Despite his work, however, the art remained lost to practical surgery until 1816, when v. Graefe again revived Tagliacozzi's method, and reported one successful case. He modified the procedure by cutting the upper pedicle at once and by sewing the fresh flap into its place without waiting for it to granulate; thus making of it a single operation.

The Indian method was brought to the attention of European surgeons by a letter which was printed in the *Gentleman's Magazine* for October, 1794, p. 891, a part of which is as follows:

“Cowasjee, a Mahratta of the caste of husbandmen, was a bullock driver with the English army in the war of 1792, and was made a prisoner by Tippoo, who cut off his nose and one of his hands. In this state he joined the Bombay army near Seringapatam, and is now a pensioner of the Honourable East India Company.

For about twelve months he remained without a nose, when he had a new one put on by a man of the brickmaker caste, near Poonah. This operation is not uncommon in India, and has been practiced from time immemorial. Two of the medical gentlemen, Mr. Thomas Cruso, and Mr. James Trindlay, of the Bombay Presidency, have seen it performed as follows: A thin plate of wax is fitted to the stump of the nose, so as to make a nose of a good appearance. It is then flattened and laid on the forehead. A line is drawn around the wax, and the operator then dissects off as much skin as it covered, leaving undivided a small slip between the eyes. This slip preserves the circulation till an union has taken place between the new and old parts. The cicatrix of the stump of the nose is next pared off, and immediately behind this raw part an incision is made along the upper lip. The skin is now brought down from the forehead, and being twisted half around, its edge is inserted into this incision, so that a nose is formed with a double hold above, and with its alæ and septum below fixed in the incision. A little terra japonica is softened with water, and being spread on slips of cloth, five or six of these are placed over each other to secure the joining. No other dressing but this cement is used for four days. It is then removed, and cloths dipped in 'ghee (a kind of butter) are applied. The connecting slips of skin are divided about the twenty-fifth day, when a little more dissection is necessary to improve the appearance of the new nose. For five or six days after the operation the patient is made to lie on his back; and on the tenth day bits of soft cloth are put into the nostrils to keep them sufficiently open. This operation is very generally successful. The artificial nose is secure, and looks nearly as well as the natural one; nor is the scar on the forehead very observable after a length of time."

J. C. Carpue of London was the first surgeon to make use of this information and, in 1814 and again in 1815, he successfully performed rhinoplasty by the Indian method. Since that time the operation has been performed many times and numerous modifications of the original method have been tried.

Bünger in Marburg in 1823 was successful in making a new nose with a free flap of skin from the patient's thigh, thus being the first European surgeon to carry out successfully the old Indian method. Graefe did not succeed with his attempts at rhinoplasty with free flaps, and Walther, Dieffenbach and Wertzer were scarcely more successful. In spite of discouraging results, these and other surgeons continued to experiment in rhinoplastic and other plastic operations, with varying success.

Rhinoplasty by gliding lateral facial flaps over the defect is called the *French method*, although for the fundamental principle we are indebted to Celsus. The utilization of it in all sorts of plastic work is invaluable. It was developed by Larrey, Dieffenbach, Bouisson, Baudens, Burow, Mütter, Szymanowski, and others.

Dieffenbach, in his work and by his writings, gave a tremendous

stimulus to plastic surgery; many of his methods have not been improved upon and are still constantly used. He advocated the granulating flap in the Italian method of rhinoplasty and advised strongly against the use of the fresh flap suggested by Graefe.

A number of names may be mentioned in connection with the development of plastic surgery, among them being those of Dupuytren, Ricard, Velpeau, Labat, Blandin, Denonvilliers, Hoffacher, Schuh, Zeiss, Burggraeve, Serre, Liston, Verhaeghe, Jobert, von Ammon, Fergusson, Ph.-J. Roux, Denucé, Langenbeck, Gurdon Buck, Verneuil, Czerny, Pollock, König, Tiffany, Gerster, Nélaton, J. S. Stone, Finney, J. B. Roberts, Lexer, and many others.

J. Mason Warren of Boston was probably the first to introduce the successful application of plastic surgery in the United States. T. D. Mütter and Joseph Pancoast of Philadelphia were also pioneers in this work. To these three men is due the credit of introducing plastic methods into American surgery.

Szymanowski, a Russian, in 1867, in his *Manual of Operative Surgery*, collected the various operative procedures for the relief of deformities requiring plastic surgery and attempted to classify them. The portion of the book devoted to plastic surgery has yet to be surpassed.

The use of the pedunculated flap of skin and subcutaneous fat, based on the Indian or the Italian method, applied to the fresh or granulating wound, gradually became more common. Especially for the relief of contractures and in locations exposed to pressure and friction.

The transplantation of a pedunculated flap by successive migration was probably first employed by Ph.-J. Roux in supplying lost portions of the cheeks; the flap was taken from the thigh of the patient (Pancoast).

Blandin reported a case in which a part of the upper lip and a part of the cheek and ala of the nose had been destroyed. He raised a flap from the lower lip, attached it to the upper lip and then transferred it successfully to the cheek and nose.

The first report of the use of a pedunculated flap from adjacent tissue by an American surgeon, is that of J. Mason Warren of Boston in 1837. He was successful in constructing a nose by the Indian method with a pedunculated flap from the forehead. T. D. Mütter of Philadelphia, in 1842, reported three cases in which he successfully shifted large pedunculated flaps of skin and subcutaneous fat from the shoulder

and deltoid region, to fill defects left by relieving contractures of the neck and chin following burns.

Joseph Pancoast of Philadelphia, in 1842, reported the successful use of pedunculated flaps from the cheeks, forehead and upper lip.

Frank H. Hamilton, on January 21, 1854, in the Buffalo General Hospital, raised a pedunculated flap of skin and subcutaneous fat 10.×17.5 cm. (4×7 inches), from the calf of a man's leg for the relief of a large traumatic ulcer of the other leg. This flap was held away from its bed with dressings and remained viable, although there was a considerable degree of shrinkage. After two weeks he freshened the under surface and edges of the flap, excised the ulcer and part of the cicatrix, then partly covered the wound with the flap and secured the legs together. Two weeks later the flap was amputated from its base, but a portion of it subsequently sloughed. It is interesting to know that, ten years before this operation was performed, Hamilton had suggested this procedure for the relief of an ulcer of the thigh, but had been unable to obtain the patient's consent. He recognized the important fact that if a graft is smaller than the chasm which it is intended to fill, it will grow or project from itself new skin to supply the deficiency, and hence that it is not necessary to make the graft as large as the defect to be covered. No wide interest, however, was evoked by Hamilton's report.

After this there were reports on the subject from the United States, England, France and Germany, but it was not until the work of Maas, 1884-86, that widespread attention was given to the use of pedunculated flaps. His papers were so convincing that a new impetus was given to the method. Since his death there has been much work done on these lines by many surgeons, and splendid results have been reported.

The original Indian and Italian methods have been modified from time to time, but their basic principles are unchanged.

THE DEVELOPMENT OF SKIN TRANSPLANTATION

In 1804, Baronio, the physiologist, did the following experiments, which he carried out on sheep:

In the first experiment, two whole-thickness pieces of skin of equal size and exclusive of the subcutaneous tissue, were cut from either side of the root of the tail of a sheep, and were immediately transferred to opposite sides. The second experiment was similar, except that the

pieces of skin were kept detached for 18 minutes. In the third experiment larger pieces were used, 12.5×7.5 cm. (5×3 inches) including the cellular tissue and a bit of muscle. These were left detached for one hour before being transferred to opposite sides. All of the above-mentioned experiments were successful, and the grafts bled when cut into 10 to 12 days after the transplantation.

J. Mason Warren in 1843, used a successful free graft of whole thickness skin from the arm, to repair a defect on the ala following a rhinoplastic operation by the Italian method.

Netolitski, on April 11, 1869, successfully transplanted small elliptic shaped pieces of whole-thickness skin from the back of the patient's hand, in the treatment of a case of avulsion of the scalp.

The hastening of the healing of granulating wounds by the use of small detached bits of skin was first demonstrated by J.-L. Reverdin. His report was made to the Société Impériale de Chirurgie, December 8, 1869. He showed a patient on whom he had successfully practised "epidermic grafting," and described the grafts as consisting of epidermis only. He says "I raised with the point of a lancet two little flaps of epidermis from the right arm, taking care not to cut the dermis." These he applied to the granulating surface. He obtained his idea by observing the epithelial growth from a spontaneous island in an ulcer case. Reverdin's paper was discussed on December 15, 1869, but the importance of his method was not appreciated. He held that the living epidermis alone was necessary for the success of the graft, and that the transplanted epidermis caused the transformation of the embryonal cells of the granulation tissue into epidermic cells. Bryant, on the other hand, subsequently declared that the grafts themselves grew, and that there was a spread of epithelium from the graft, and this view has been proved correct, as it is now a well-known fact that epithelium is only derived from preexisting epithelium.

Pollock of London, heard of Reverdin's method in May, 1870. After trying it on several chronic cases he was very much impressed with his results and the method was immediately taken up by numerous surgeons in England, Scotland and Ireland. It soon became known in America, and in 1870-71 successful cases were reported by Frank Hamilton of New York, Chisholm of Baltimore, Coolidge of Boston, and others.

In his exhaustive paper on the subject published in 1872, Reverdin says in part: "The title 'epidermic grafts' is not perfectly correct, as the transplanted bit is composed of the whole epidermis and a very

little of the dermis." He said that if the epidermis alone could be transplanted, the same result would be obtained as when a part of the dermis was included.

It is interesting to note that Reverdin developed his method of grafting before the introduction of antisepsis and asepsis in surgery, and that it is probably the only type of graft which could have given satisfactory results under such conditions.

The results obtained by the method of Reverdin were not all that had been anticipated, and although the healing was hastened, it was found, especially in the region of joints, that this method of grafting did not prevent contractures. This fact stimulated investigation and Ollier of Lyon in 1872 grafted much larger areas of skin, 4., 6. and 8. cm. square ($1\frac{3}{5}$; $2\frac{2}{5}$, $3\frac{1}{5}$ inches) in extent, using the entire epidermis with a portion of the dermis, instead of the small bits of epidermis 0.3 to 0.4 cm. square ($\frac{1}{8}$ to $\frac{3}{16}$ inch) as advised by Reverdin. His idea was not to create multiple centers of epidermization, but to substitute for the ordinary healing a surface having the essential elements of the normal skin surrounding it. This conception represented a distinct advance and formed the essential foundation of the method later elaborated by Thiersch. Ollier's work was ignored by his countrymen, as Reverdin's had been.

Thiersch, in 1874, transplanted whole thickness pieces of skin 1. cm. ($\frac{2}{5}$ inch) in diameter, from which the adipose tissue had been carefully removed. He laid great stress upon the following facts: that upon perpendicular sections of the granulation tissue one can easily distinguish upon the deeper part quite dense connective tissue, and a vascular network in a horizontal position. From this horizontal vessel and tissue layer sprouts the much softer and more vascular true granulation tissue, "*granulation caruncle*," and that unless we render it possible for this soft vascular "*granulation caruncle*" to change into a firm cicatrix, then the graft over it will sooner or later break down; hence (he argued) that nothing remains but to exclude the superficial part of the granulations from the procedure, and to graft the skin immediately upon the lower horizontal ground. This idea has been proved fallacious.

Thiersch held that the agglutination took place within a layer of subcutaneous cement substance; that the agglutination, if entirely successful, resulted from the inosculation of the vessels which could be seen in 18 hours, in other words, the connection between the vessels of the granulation tissue and the applied skin took place through inter-

cellular ducts, which filled it immediately with blood from the granulation vessels, and that this blood then circulated in the vessels of the applied skin. Moreover, he held, that the vessels of the transplanted skin were liable to a secondary change in which their structure approached, for a while, more or less that of the granulation vessels.

In 1886 Thiersch read the report of his perfected method of skin grafting at the Fifteenth Congress of the German Surgical Association. He showed that the healing of wounds of any size could be brought about more quickly by covering the defects with large films of epidermis together with a portion of the dermis: These films were shaved off and placed so as to entirely cover the wounds from which granulation tissue six weeks old had been removed.

The method became widely known as Thiersch grafting, no credit being given to the priority of Ollier's work. In all justice the proper title should be the *Ollier-Thiersch* method. These large grafts completely superseded the smaller grafts recommended by Reverdin, and his method was almost forgotten.

W. S. Halsted early in 1890 showed a case before the Johns Hopkins Hospital Medical Society in which a leg ulcer, 20. X 12. cm. ($8 \times 4\frac{1}{2}$ inches) and of 14 years' duration, had been successfully grafted with Ollier-Thiersch grafts. He said that Thiersch scraped the ulcer and planted his grafts on the scraped and necessarily infected surface. The surface being infected, it was necessary for the dressing to be changed every day for about one week. Dr. Halsted's method was to cauterize the ulcer thoroughly with pure carbolic acid and then excise it, taking care not to infect the fresh surface thus made, and then plant the grafts on this fresh aseptic surface after which the dressings need not be changed for at least one week.

The excision of the base of scar tissue and planting grafts on healthy clean tissue was a marked advance.

The Ollier-Thiersch method did not fulfil all expectations. Contractures took place under grafts of this type and there was little resistance to mechanical insults. Hence surgeons were constantly trying to find some method by which soft, elastic, resistant healing could be obtained.

Going back to earlier investigators we find that Lawson in London, in 1871, had used successfully for the relief of ectropion a large thick Reverdin graft of the whole thickness of the skin, free from fat. LeFort in France in February, 1872, successfully transplanted from the arm for the relief of ectropion a free graft from which the subcutaneous

fat had been removed. Good results were also obtained by several other men about this time.

In 1875, Wolfe of Glasgow, reported a successful plastic operation for the repair of a defect about the lower eyelid, with a free whole thickness graft from the arm, measuring 2.5×5 cm. (1×2 inches), from which all the subcutaneous fat had been removed. He is generally accredited with introducing this method, and with insisting on the complete removal of the subcutaneous fat, although Lawson, in 1871, and LeFort, in 1872, had done practically the same thing. At any rate to Wolfe is due the credit of establishing the method in ophthalmic practice.

Esmarch and others used the method with success, but to Krause of Altona is due the credit of introducing it into general surgery. The method should be called the Wolfe-Krause method.

Krause reported his perfected technic at the Twenty-second Congress of the German Surgical Association, and advised the use of the whole-thickness graft for all purposes where the Ollier-Thiersch graft had been found lacking. He reported 21 cases, and found that skin from any location could be used after the removal of the subcutaneous fat.

Hirschberg, at the afternoon meeting of the same day claimed priority for the use of whole-thickness skin grafts with subcutaneous fat. He said that hyperemia should be induced before excising the graft with the fat and that this might be accomplished by beating the part with a piece of rubber tubing, thus repeating to a certain extent the old Indian method. He also thought that only skin with a very dense vascular network should be used. Krause opposed these ideas of Hirschberg, and further investigation has proved that there is no advantage in hyperemia and that there is a distinct disadvantage in the presence of fat.

The Wolfe-Krause method was used in suitable cases for some time, but the larger operative procedure as compared with the Ollier-Thiersch method discouraged its general use.

In 1905 Young of Glasgow, suggested various modifications of Krause's technic.

In this brief historical review of the subject I have endeavored to touch only upon the main features in the development of plastic surgery. Many names famous in plastic surgery have been omitted, but I shall endeavor in the pages that follow to give these names prominence in the chapters in which their particular work is considered.

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CHAPTER II

GENERAL CONSIDERATIONS

The utilization of those skilled in well-established medical and surgical specialties in the care of sick and wounded soldiers, has been successfully demonstrated to the medical organizations of the various armies for the first time during the present great world war.

In the Medical Corps of our own Army in all previous wars, and even up to the last two years, specialties were not recognized as such, and an officer of the Medical Corps whether professionally equipped or not, was too often assigned to take care of cases requiring the attention of a highly trained specialist. To my mind the recognition of the specialist in the Medical Corps of the Army is a great step forward, as it insures the soldier the best care in every kind of injury or illness.

For many years as I have become more and more familiar with the intricacies of plastic surgery, I have urged, in spite of much opposition, that this be made a surgical speciality, and the war has demonstrated beyond a doubt the need of this as a special branch.¹

There are large hospitals in all the warring countries devoted entirely to plastic surgery of the face, and in our own organization, under the Section of Surgery of the Head, there is a subdivision of Facial Plastic and Oral Surgery, to deal with reconstructive work on the face. This is all very well as far as it goes, but it must be understood that reconstructive work on the face, although vitally important, is only a part of plastic surgery, and that plastic and reconstructive work is as necessary and is just as important on other parts of the body.

Except for the vastly greater number of cases and the greater prevalence of injuries and destruction of the bony framework, the real plastic and reconstructive work on war wounds differs not a great deal from that done in civil practice.

By **plastic and reconstructive surgery** is meant that branch of surgery which deals with the repair of defects and malformations, whether congenital or acquired, and with the restoration of function and the improvement of appearance. This is accomplished chiefly by the transfer of tissue, either from the immediate neighborhood, or from some

¹ Davis, J. S.: Jour. Amer. Med. Assn., July 29, 1916, p. 338.

listant part. The deformities dealt with in plastic surgery for the most part involve the skin or adjacent soft parts, rather than the bones and joints, the ligaments or tendons. The treatment of large denuded surfaces, requiring skin grafting, and of intractable surface wounds, should also come under the care of the plastic surgeon.

It is imperative that the surgeon who expects to do plastic and reconstructive work should have had a thorough general surgical training before attempting to specialize in this branch. Above all he must know, and thoroughly appreciate the principles governing the healing of tissues and the repair of wounds. A special knowledge of the resistance and utility of tissues more or less infiltrated with scar tissue is also necessary, because in many instances normal tissue is unavailable. A knowledge of the surgical handling of children is also very important in civil practice.

In reconstructive surgery of the jaws and palate, the plastic surgeon should have the constant advice and coöperation of a skilled dental and oral surgeon. This combination has proved to be of inestimable value in France and England, and also in Germany, where those of the wounded who require reconstructive work on the face are concentrated in special hospitals.

In choosing an operation for the repair of a defect on the face or other exposed portions of the body, care must be taken that the scar left by shifting the flap used for this repair does not cause the patient as much concern as the original defect.

My experience has been that we seldom, if ever, find two plastic cases exactly alike, and that no cut and dried methods can be employed. Each case should be carefully studied, and the various methods of repair considered from every standpoint. This endless variety in itself brings a certain fascination to the operative treatment and to the after-care of these patients. Sound surgical judgment is often necessary to determine what should be done; whether or not a plastic procedure should be finished at one operation; how far to go in the initial operation, and when to follow with the secondary procedures. The results in certain groups of cases are very slow, and in these the process is one of gradual building up. In such cases the entire series of operations should be planned with regard to the ultimate result and not to the immediate relief of the condition. The post-operative treatment and dressings should be done by the surgeon himself or directly under his eye, because successful results in a great measure depend on skillful and judicious after-treatment.

The simpler the operation the more likely it is to succeed, and this is especially exemplified in the operations for the relief of harelip. It is wise to make haste slowly in plastic surgery, and to underdo rather than overdo.

The plastic surgeon, with his special knowledge of tissue transplantation, can be of great use to the general surgeon, and to the orthopedist in dealing with scars and in repairing the defects left by certain necessarily mutilating operations. This applies also to the gynecologist, and genito-urinary surgeon, when their patients require more extensive transplantations than these specialists are accustomed to undertake.

Plastic surgery cannot be done in a hurry, either in the operative steps in the process or in the length of time required to complete the final operation. Frequently in complicated cases single operations require several hours to complete, on account of the great detail necessary and the difficulties encountered in carrying out the work. Sometimes the patient may be in the hospital for months (combating infection), before he is even ready for operation, and then be obliged to undergo several major operations with interspersed minor procedures. Ten, twenty, and even more operations may be necessary to accomplish the desired result, and thus it can readily be seen that this work is a tremendous tax on both patient and surgeon. Fortunately, the majority of the patients requiring these operations are endowed with extraordinary fortitude, and occasionally the surgeon is found who is able to give his interested attention to this work.

Thorough familiarity with the free transplantation of skin, fat, fascia, bone and cartilage, is essential, as all of these tissues are constantly utilized in reconstructive work. The principles of tissue shifting and of the use of pedunculated flaps must be understood, and also the possibilities of combinations with the above-mentioned free transplants.

For all sorts of plastic operations it is desirable that the patient should be in the best possible physical condition, and no plastic operation should be undertaken on those still suffering from active local disease. A complete physical examination should be made of each case before operation, and in children the urine should be examined with special reference to the presence of acetone and diacetic acid. Low hemoglobin contraindicates operation on the ordinary case, and I seldom care to operate when the percentage is below 75. If there is

bronchial irritation, or rise of temperature at the time selected for operation, it is safer to defer the work.

Asepsis rather than antiseptis should be maintained throughout the operation, and during convalescence, since infection is one of the chief causes of failure. It goes without saying that rubber gloves should be worn by the operator and all assistants.

The tissues should be treated with the greatest consideration. Keen-cutting instruments must be used to avoid unnecessary bruising of the tissues. The flaps should be handled with special forceps, or small sharp hooks (Fig. 1). The area into which the flap or graft is to be transferred should be perfectly dry, and all hemorrhage checked, in as much as many failures are due to a blood clot forming beneath the transplant, which prevents the early acquisition of a new blood supply.

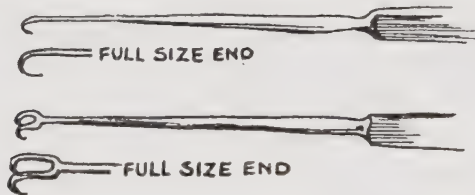


FIG. 1.—Single and double sharp hooks for handling flaps.

If possible, all scar tissue, deep or superficial, should be removed. An accurate estimate of immediate and subsequent tissue shrinkage must be planned for. Accurate apposition of the skin edges is desirable, as prompt healing minimizes scar tissue.

One of the most important points in plastic surgery when tissue of any kind is transplanted, is that there be *no tension* either on the flaps, or on free grafts. *Always remove a suture if it blanches the tissue, or causes too much tension.* I like to see a surgeon who, when doing plastic work does not hesitate, in spite of his audience, to take out sutures which are too tight or which have not been placed exactly to suit him.

As a rule prosthesis should be avoided, as it is rare in plastic surgery that we encounter a deformity which cannot be helped by logical surgical methods. At best the surgeon can accomplish only a certain amount, nature (when obstacles are removed) being relied on to complete his work.

To sum up the matter, in the words of Sir Frederick Treves,¹

"No branch of operative surgery demands more ingenuity, more patience, more forethought, or more attention to detail."

¹ Treves, Sir Frederick: *Manual of Operative Surgery*, ii, p. 104.

DEFINITION OF TERMS

In this work the following definitions will be used. By a *flap* we mean a mass of tissue attached at some portion of its margin or its base by a pedicle through which it receives its blood supply, and which can be shifted at once, or subsequently, as far as the pedicle will allow.

By a *graft* we mean a mass of tissue which is cut free to be transplanted wherever necessary. An *autograft*, is a graft obtained from the same individual; an *isograft*, is obtained from another individual but of the same species; a *zöograft*, is obtained from a lower species.

The term *take* means that the entire graft has been successfully transplanted and has healed in its new bed. A *partial take* means that only a portion of the graft has been successfully transplanted.

METHODS OF CLOSING DEFECTS

A surface defect which cannot be closed by simple suturing, may be closed in one of four ways: (1) By *skin grafting*; (2) By the *French method*, that is, by gliding the edges together and suturing. This method was originally devised by Celsus, but has been especially developed by the French. Where there is tension the skin may be mobilized to a great extent by undercutting, and in this way large areas of skin may be shifted without impairing the vitality. (3) By the *Indian method*, that is, by using pedunculated flaps from tissue in the immediate neighborhood with more or less torsion of the pedicle. This method has its limitations, as in some instances healthy flaps from adjacent tissue are impossible to obtain especially where a defect is situated in the midst of scar tissue. (4) By the *Italian or Tagliacotian method* by using pedunculated flaps from distant parts. This may be accomplished by a single or double transfer. It is as a rule easy to secure sufficient tissue with flaps from distant parts, but the constrained position necessary in order to utilize these flaps is very irksome to the patient, and many are unwilling or are physically unable to endure the discomfort.

PLASTIC OPERATIONS FOR CLOSING DEFECTS OF VARIOUS SHAPES

In making a defect which will later have to be closed by plastic operation, it is desirable that the contour of the defect should be as simple and as regular as possible.

The simplest method of closing defects of moderate size is by approximation of the edges. In order to accomplish this it may be necessary to undercut the skin, and if this does not give sufficient relaxation then liberating incisions should be made.

The concavity of the semilunar, or broad V-shaped relaxation incisions should be toward the defect, and the incision should be only through the cutis. Relaxation incisions may be made on one or both sides, as may be necessary. The defects left by the relaxation incisions may either be skin grafted or allowed to granulate.

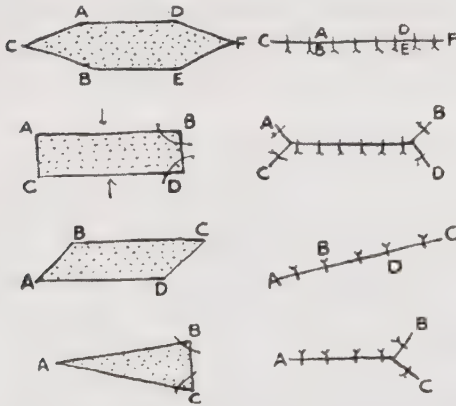


FIG. 2.—Plastic operations for closing small defects by undercutting and approximating the skin edges. (*Esmarch and Kowalzig.*)

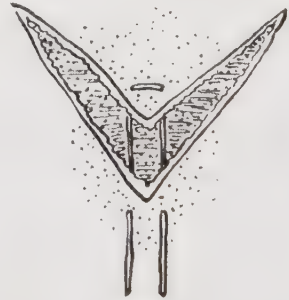


FIG. 3.—Method of coapting the angle of a wound. The dotted area shows the portion undermined. (*Moorhead.*)

Defects of various shapes may be closed by means of pedunculated flaps from the adjacent skin. This method is applicable for the closure of much larger defects than can be closed by undercutting and sliding.

The following figures 2 to 43 which explain themselves, will give a few suggestions as to the various plastic methods which may be utilized in closing defects of different shapes, and may be modified to suit conditions.

Preparation of the Part from which the Graft or Flap is to be Taken.—Two methods of cleansing the skin have been found serviceable in my work. (1) Shave the part selected, then scrub carefully with green soap and water; rinse with sterile water; sponge with ether followed by alcohol; then rinse with sterile normal salt solution. This method is seldom used on the face. Elsewhere on an unbroken surface it is without doubt most dependable, but is slow of execution, is sloppy, and is more or less disagreeable to the patient.

Plastic closure of defects of various shapes by undercutting and sliding.

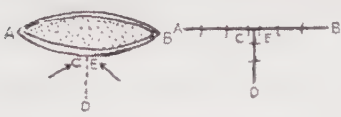


FIG. 4.—Lisfranc's method.
(Szymanowski.)

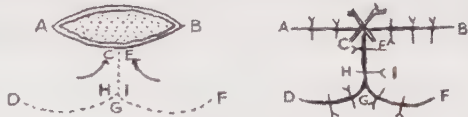


FIG. 5.—Szymanowski's method.



FIG. 6.—Cole's method.

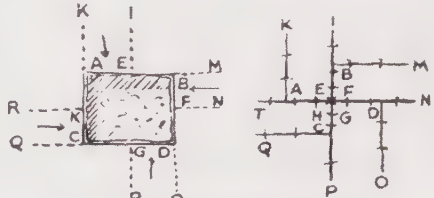


FIG. 7.—Szymanowski's method.

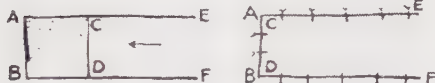


FIG. 8.
FIGS. 8 and 9.—Szymanowski's method.

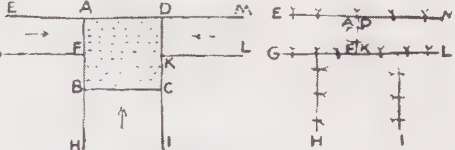


FIG. 9.

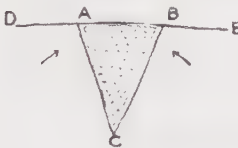
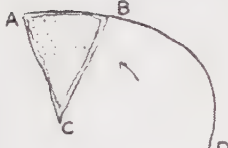


FIG. 10.—Jäsche's method.
(Szymanowski.)

FIG. 11.

FIGS. 11 and 12.—Szymanowski's method.



FIG. 12.

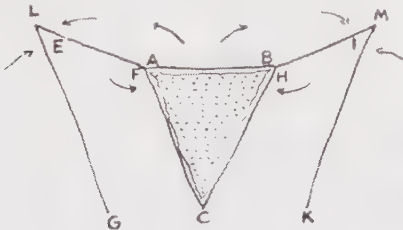


FIG. 13.—Szymanowski's method.



FIG. 14.—Szymanowski's method.

(2) After a dry shave paint the part with $2\frac{1}{2}$ per cent tincture of iodine (the U.S.P. tincture being 7 per cent) two or three coats, either on the dry skin or after sponging it with benzine or ether. This is a

Plastic operations for closing defects by undercutting and slicing. Showing the types of relaxation incisions.



FIG. 15.—Method of Celsus.
(Szymanowski.)

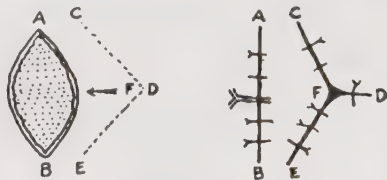


FIG. 16.—Dieffenbach's method.
(Szymanowski.)

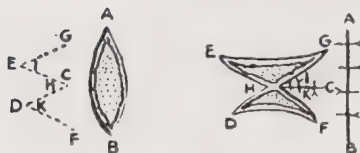


FIG. 17.—Guérin's method.
(Szymanowski.)

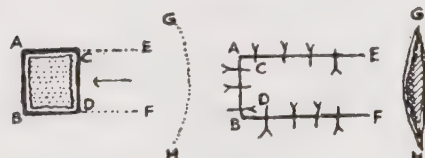


FIG. 18.—Dieffenbach's method.
(Szymanowski.)

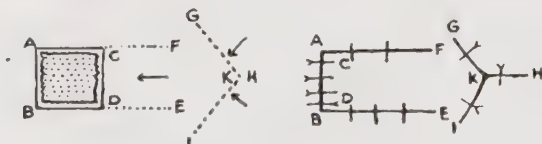


FIG. 19.—Szymanowski.

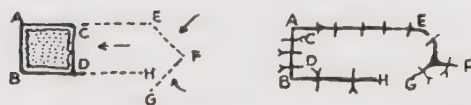


FIG. 20.—Szymanowski.

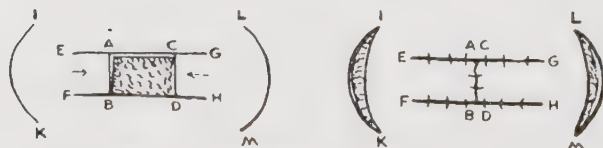


FIG. 21.—Method of Lexer-Bevan.

quick and satisfactory method, and is especially useful on the face, where scrubbing is impracticable.

I do not believe that stronger solutions of iodine should be used in this work, unless the excess is immediately washed off with alcohol.

The disadvantage of iodine is the occasional burn which it may cause, and in a few cases a very disagreeable rash may develop when there is an idiosyncrasy to this drug. Strong antiseptics of all sorts, other than iodine, are contraindicated on grafts or flaps.

Plastic closure of circular defects by the excision of triangles, with undercutting, sliding and suture.

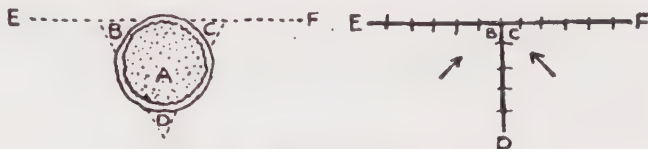


FIG. 22.—Szymanowski's method.

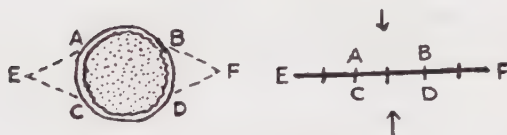


FIG. 23.—Szymanowski's method.

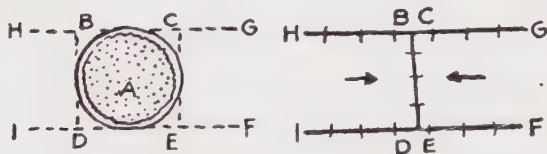


FIG. 24.—Szymanowski's method.

ANESTHESIA

LOCAL ANESTHESIA should be employed whenever possible. This may be effected by infiltration along the line of incision, or by nerve blocking. The infiltration method as a rule causes very little trouble in the healing of the wounds, but there is no question that in doubtful tissue this method lowers the resistance of the edges, and the healing may not be quite so satisfactory. I find that 0.5 per cent novocaine, procaine, or apothesine, with from 5 to 10 drops of adrenalin chloride (1-1000) to 30. c.c. (1 ounce) a safe local anesthetic for general use, and for nerve blocking 1 per cent is efficient.

Macht has recently described the anesthetic properties of benzyl alcohol (phenmethylol), and I have used this substance with success (in infiltration anesthesia), in strengths of from 1 to 3 per cent in normal salt solution, and in nerve blocking in a 1 per cent strength.

Method of closure of defects (not circular) by the excision of small triangles of normal skin followed by undercutting, sliding and suture.

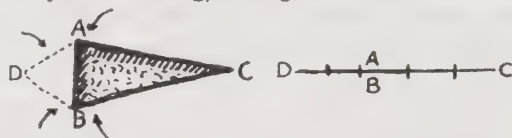


FIG. 25.—v. Ammon's method. (Szymanowski.)



FIG. 26.—v. Ammon's method. (Szymanowski.)

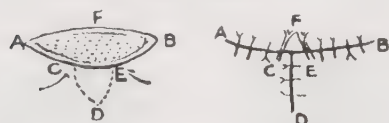


FIG. 27.—Szymanowski's method.

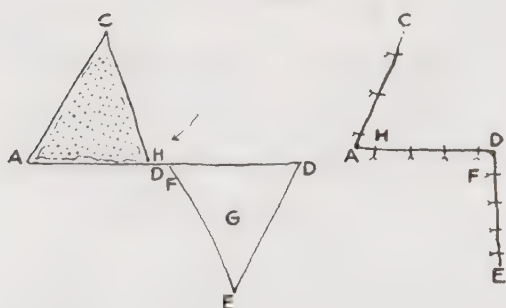


FIG. 28.—Burow's method. (Szymanowski.)

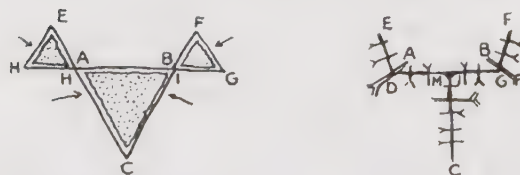


FIG. 29.—Burow's method. (Szymanowski.)

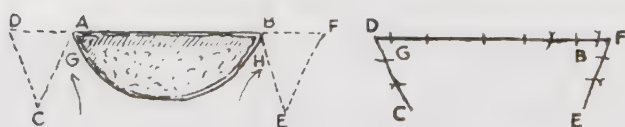


FIG. 30.—Szymanowski's method.

Method of closure of defects (not circular) by the excision of small triangles of normal skin followed by undercutting, sliding and suture, *continued*.

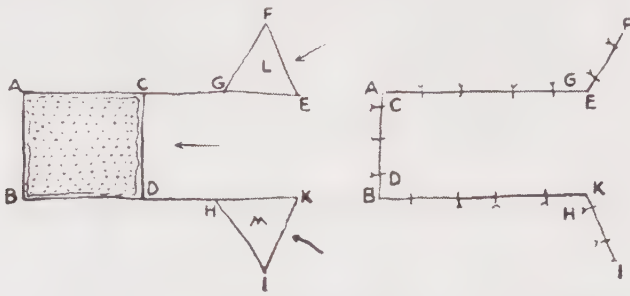


FIG. 31.—Burow's method. (Szymanowski.)

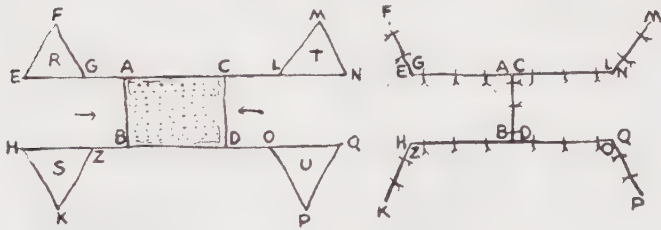


FIG. 32.—Burow's method. (Szymanowski.)

Method of closing defects by means of pedunculated flaps from adjacent skin.

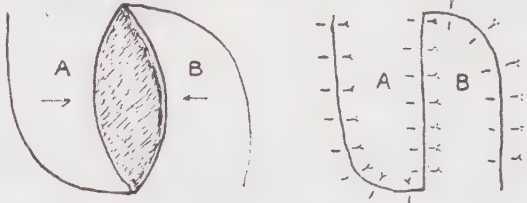


FIG. 33.—Bilateral flaps with one pedicle above and one below.

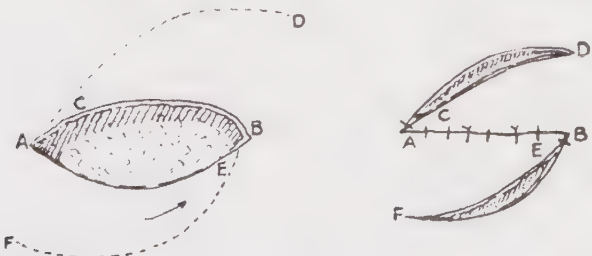


FIG. 34.—Hasner's method. (Szymanowski.)

Methods of closing defects by means of pedunculated flaps from adjacent skin, *continued*.

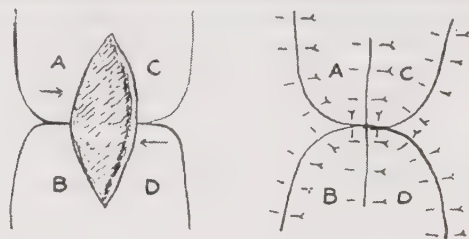


FIG. 35.—Double bilateral flaps with pedicles above and below.

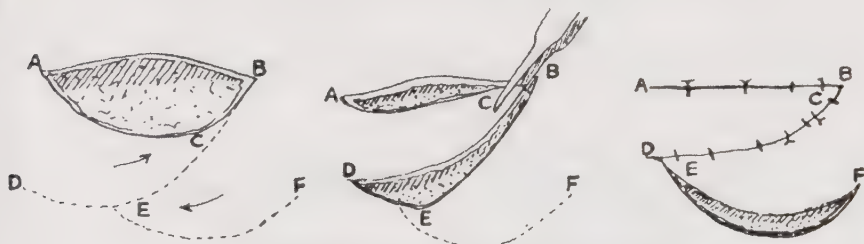


FIG. 36.—Weber's method. (*Szymanowski*.)

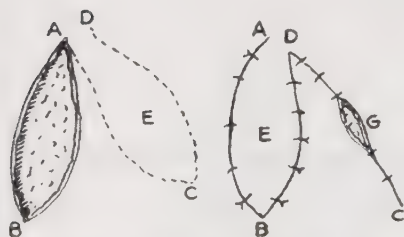


FIG. 37.—*Szymanowski's* method.

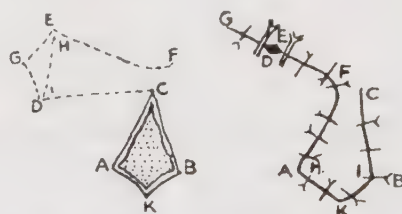


FIG. 38.—*Szymanowski's* method.



FIG. 39.—*Szymanowski's* method.

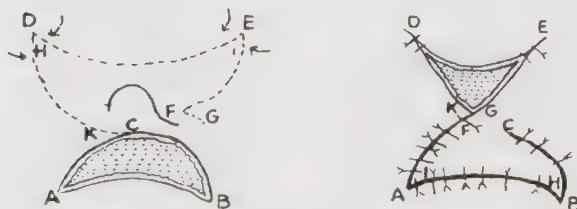


FIG. 40.—*Szymanowski's* method.

Methods of closing defects by means of pedunculated flaps from adjacent skin, *continued*.



FIG. 41.—Szymanowski's method.

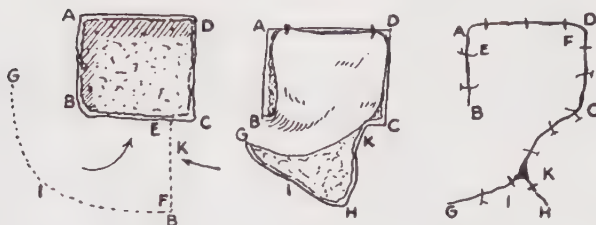


FIG. 42.—Letenneur's method. (Szymanowski.)

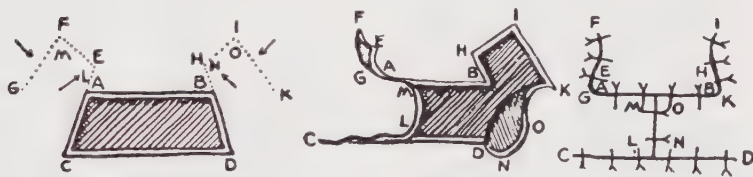


FIG. 43.—Brun's method. (Szymanowski.)

It can be used both with and without adrenalin (5 to 10 drops to 30 c.c. (1 ounce)). It has the advantage of being practically non-toxic; it is easily metabolized, and excreted in an innocuous form; it can be sterilized by boiling and is comparatively inexpensive.

GENERAL ANESTHESIA must be used in many instances. The choice of anesthetic must depend on circumstances, although ether is usually to be preferred, given by the drop method, or in selected cases by the intratracheal route. Combination anesthesia may be used with advantage in some long cases; a portion of the work being done under local anesthesia, for instance in securing a cartilage graft, and the remainder under a general anesthetic.

General anesthesia with nitrous-oxide-oxygen, and ethyl chloride, may be used in suitable cases. Where a general anesthetic is used, especially in face and mouth cases, it is essential that the anesthetist should be an expert.¹

¹ For more detailed information on local anesthesia, the reader is referred to "Local Anesthesia" by Braun & Shields, 1914, and "Local Anesthesia," 2d. ed., 1918, by C. A. Allen.



FIG. 44.



FIG. 45.

FIGS. 44 and 45.—Langer's lines of cleavage of the skin. (*Modified from Kocher.*)

In all operations in which a narrow inconspicuous scar is an object, the incision should be made parallel to the tension lines. If this is done there will be little gaping of the wound. If the incision is made across these lines wide gaping will occur and a more conspicuous scar will result.

INCISIONS AND METHODS OF CLOSURE

The incisions used in plastic surgery should as far as possible be made parallel to the tension planes of the skin (Figs. 44 and 45). In many cases curved incisions will accomplish more than straight ones.

On the face the natural lines should be followed, and if this is not possible, the incision should be made parallel to these lines and not across them.



FIG. 46.—Method of making slanting incisions. (Aymard)

A. Schematic drawing of usual incision at right angles to the surface. (1) Skin. (2) Subcutaneous tissue.

B. Beveled or slanting incision.

C. Position assumed by edges after the incision is made. It can be easily seen that accurate closure of this incision is difficult on account of the thin lip of epithelium on the overlapping margin.

The incision through the skin made at right angles to the surface is generally used, as it can be utilized in nearly every situation. Oblique incisions through the skin have been used for many years (being mentioned by Pancoast in 1842), on the ground that the resulting scar will be less conspicuous. Recently G. L. Aymard has emphasized this point. His contention is theoretically true, but in my experience

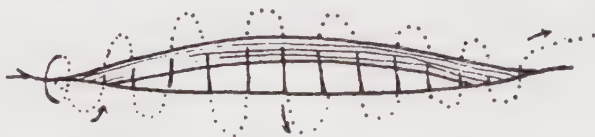


FIG. 47.—Halsted's subcuticular suture.

The needle does not penetrate the epithelial surface except at the beginning and ending of the suture. When the suture is of non-absorbable material, such as silver wire, it is advisable to loosen it in the tissues as it is being inserted, otherwise it may stick and break when an attempt is made to remove it.

the thin overlapping lip of epithelium is difficult to approximate accurately, and the result is not appreciably better than that obtained in a carefully closed wound made at right angles to the surface (Fig. 46).

When the edges of a defect opening into a cavity, such as the mouth, are thin, and where paring would add little to the desired thickness, it is better to split the edges;¹ then close with two layers of sutures, so

¹ Duncan, John: Linear Incisions and Everting Sutures, Edinburgh Hosp. Reports., Vol. 1, 1893, p. 451.

placed as to evert both the inner and outer edges. This may be done with one double vertical mattress suture which unites both skin and mucous membrane, and will accomplish the same purpose. This method of splitting is especially useful in certain harelip cases, where



FIG. 48.—The on-end mattress suture. (McMillen.)

1. Begin as in any interrupted suture.
2. Either thread the other end of the suture or reverse the needle in the holder and pass it through the skin very close to the margin.
3. The sutures tied and the edges slightly everted are held in approximation.

the margins are thin; also in conserving all the tissue in the soft palate, as suggested by Davies-Colley and H. M. Sherman.

In the hands of an expert Halsted's subcuticular suture is the ideal method of closing a skin wound, where there is no tension. This

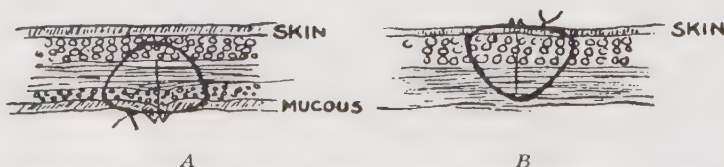


FIG. 49.—Methods of using the on-end mattress suture for the skin and mucous membrane.

A. Showing the on-end mattress suture for everting the edges of the mucous membrane as used by Blair.

B. The same stitch applied to the skin.

suture was originated as an interrupted suture tied beneath the skin, but it was soon found that a continuous removable skin suture was preferable (Fig. 47).

The single on end or vertical mattress suture described by McMillen

for the skin (Fig. 48) and modified by Blair to prevent overlapping of the edges in suture of the mucous membrane, is, on the whole, the most satisfactory skin suture I have used in plastic work, as it prevents retraction and unevenness of the epithelial edges of the wound (Fig. 49). A continuous suture of a similar type described by C. S. White is also useful (Fig. 50).



FIG. 50.—Continuous on-end mattress suture. (C. S. White.)

This is an excellent suture and can be inserted very rapidly.

These special methods of suturing in addition to the proper use of the ordinary interrupted suture, the continuous and the mattress suture (plain or modified), are sufficient for all plastic work. *It is imperative that no suture of any kind should be tied too tightly.*

All tension should be relieved by tension sutures, either buried or removable, and to prevent spreading of the scar, the fascia under the skin should be carefully sutured.

An excellent removable tension suture which leaves no scar is described by R. L. Dickerson. The double test-tube or roll of gauze in this method can

be used with either metal skin clips, or with the single on end mattress

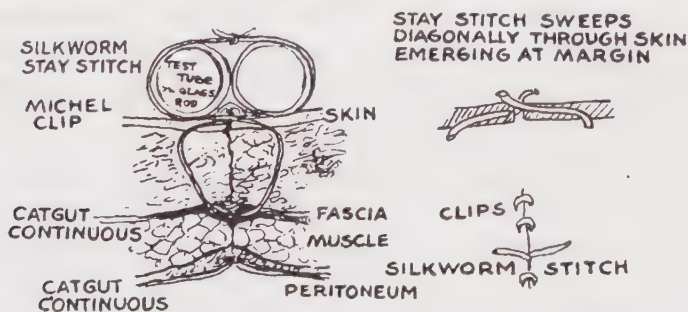


FIG. 51.—A removable scarless tension suture. (Dickinson.)

The diagram shows only the skin and subcutaneous fat included in the suture. This may be made more effective by passing the silkworm gut further away from the incision, and as deep as desired.

suture, without causing depression of the everted epithelial edges (Fig. 51).

The sutures approximating the skin edges should be removed in from three to five days, and leave little scarring.

Needles and Suture Materials.—In plastic work, I prefer to use small cervical needles for the buried sutures when they are necessary, and

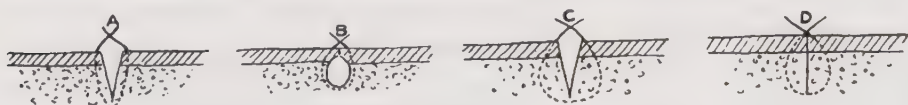


FIG. 52.—Method of inserting interrupted sutures.

A and B. Wrong method. The tissues below the skin are not approximated. C and D. Proper method. All the tissues are approximated and no dead space is left.

cattgut for the suture material if there is any possibility of infection, otherwise, fine silk is preferable. For the skin, I find half curved cor-

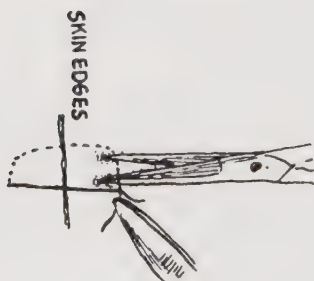


FIG. 53.

FIG. 53.—Method of removing an interrupted suture.

One side of the suture is raised out of the tissues and the portion which has been buried is cut close to the skin, and the suture drawn through.

FIG. 54.—Types of needles useful in plastic surgery.

1 and 2. Small cutting needles designed by Lane for cleft palate work. They are very useful for this purpose, and also in positions where a very short needle is necessary.

3. A cutting needle about the size of the small round French needle, but easier to force through resistant tissues.

4 and 5. The small and large corneal needles. There is a size between these. I prefer this type of needle for closing the skin, as it causes the minimum amount of damage.

6. The small cervical needle which is useful for passing buried sutures.

7. The straight intestinal needle which can be used for many purposes. If a very short straight needle is required, this thin needle can be broken anywhere in its length, and will pass through the tissues without difficulty. The centimeter scale above will give the actual size of the needles.

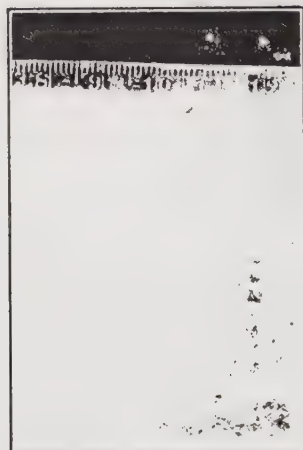


FIG. 54.

neal needles satisfactory, and use horsehair preferably, then very fine silk, silkworm gut, or silver wire, depending on the indications (Fig. 54). Special small curved needles (Lane) are used for cleft palate

work. In the mouth I find that silkworm gut and horsehair are best for the hard and soft palates, and fine silk for the uvula. For the mucous membrane of lips, cheeks and tongue, silk or catgut is used, as indicated. For ligatures fine silk or catgut should be used. For tension sutures I use silkworm gut or silver wire, tied over metal plates, vulcanite buttons or rubber tubing.

Methods of Closing Wounds Without Sutures

It is inadvisable at times to insert stitches, although it is necessary that the edges of the wound should be approximated. Sterile strips of adhesive plaster may be used to hold the margins of a wound in apposition. Strips of adhesive plaster applied close to, and parallel with, the edges of a wound may be sutured to each other, and accomplish the same purpose.

Strips of muslin to which hooks have been sewed may be glued to the skin with one of the adhesive mixtures mentioned below, and the edges of the wound may be approximated by lacing.¹ The edges may be held together by strips of sterile crepe lisse which are fastened to the skin with flexible collodion, and this is especially valuable for closing wounds of the face. Small metal clips of various kinds may also be used to approximate the skin edges and cause little pain or scarring. Broad bands of adhesive plaster, or muslin, to which hooks have been sewed may be placed outside the margin of granulating wounds, and the size of these wounds be gradually diminished by continuous elastic traction exerted by rubber bands placed on these hooks, and crossing

¹ Adhesive mixtures for gluing muslin bands or dressings to the skin.

Heussner's Glue.—Rosin 25. gm.; alcohol 90 per cent, 25. c.c.; Venetian turpentine 0.5 c.c.; benzine 5.0 c.c.

Glue used by Polonowski & Durand.—Rosin 20. gm.; ligroin 2.5 c.c.; spirits of turpentine 1. c.c.; alcohol 10. c.c.

Dieterich's Varnish.—Rosin 15. gm.; Venetian turpentine 1. c.c.; castor oil 0.5 c.c.; benzol 35. c.c.; soda bicarb. 3. gm.; amyl acetate 0.3 c.c.

Sinclair-Smith's Glue.—Common glue 25. gm.; water 25. c.c.; glycerin 1. c.c.; thymol 0.5 gm.; calcium chloride 0.5 gm. This mixture should be applied hot, and can be used without shaving the part if it is painted on the skin in a direction opposite to that in which traction is to be made.

I have used the mastic dressing of Borchardt (pure gum mastic 40. gm.; benzol 60. c.c.; castor oil 20 drops) for gluing dressings to the skin, but it is difficult to handle as it dries very slowly, and remains sticky for a long time.

All of these mixtures are satisfactory. The part should be shaved if possible, and washed with ether or benzine. Then the mixture should be painted on, and the band or dressing applied over the painted area. After the mixture has dried the lacing may be done or the elastic bands be put in position.

the wound in various directions. Muslin applied in this way will stay adherent to the skin from ten days to two weeks, and is much more stable than adhesive plaster. There is sometimes slight irritation of the skin, but no more than is caused by adhesive plaster.

HEMORRHAGE

PRIMARY HEMORRHAGE.—All bleeding vessels of any size should be clamped and tied with catgut or fine silk. Smaller vessels may be controlled by pressure or by pinching or twisting with forceps. An oozing point that persists can often be checked by touching it with a fine-pointed cautery. The application of 1-1000 adrenalin is sometimes advisable. Gauze saturated with hot salt solution is also efficacious in stopping a general oozing, as is also a 3 per cent peroxide of hydrogen solution. Horseley's bone wax (carbolic acid 1 part, olive oil 2 parts, white wax 7 parts) may be used to plug a bleeding point in bone by forcing it into the defect. Bits of muscle, fat or fascia, may be used to check hemorrhage.

On the scalp, or in angiomatous tissue an over and over continuous whipstitch is of great use.

Temporary packing with gauze may be necessary, and this is often a very efficient method of checking hemorrhage. The gauze is removed in from three to four days, and if the wound is aseptic, secondary suturing may then be carried out.

POST-OPERATIVE HEMORRHAGE.—This is usually due to the slipping of a ligature, or the expulsion of a clot. The best treatment is to catch the vessel and tie it, or to leave the clamp in place for a day or two, if it is impossible to tie. Occasionally it is necessary to tie the vessel proximal to the bleeding point. Packing is often sufficient after the removal of clots and cleansing of the wound.

SECONDARY HEMORRHAGE.—This as a rule occurs several days after operation or injury, and is usually due to sepsis with erosion of a vessel. This has been a complication in war wounds of the jaws, which has caused considerable trouble. The treatment is the same as that for post-operative hemorrhage.

DRAINAGE

Whenever there is possibility of serum or blood collecting beneath a flap or where infection is feared it is advisable that provision be made

for drainage. This is especially important after shifting double-pedicled flaps on the neck, or from the neck, to the chin, or the lip. The drains should be small, and should be placed in the angles at the most dependent portion of the wound. Among the best materials for this purpose are folded strips of rubber protective, ordinary rubber bands, very small flat cigarette drains of iodoform gauze and rubber protective. Several strands of twisted catgut; silkworm gut, or horsehair, may be used. Silver wire bent in the shape of a narrow hairpin is useful in selected positions. Narrow strips of thin celluloid folded lengthwise are sometimes satisfactory, when long continued drainage is necessary. Ordinarily in uncomplicated cases drains should be partially removed within twenty-four hours, and completely removed after three days. This applies to the non-absorbable drains. The catgut drains are usually absorbed promptly and removal is unnecessary.

DRESSINGS

The part should be immobilized as effectively as possible by means of plaster of Paris, crinolin, splints, or in any other suitable manner, since physiologic rest is important. Soft, carefully applied non-irritating dressings should be used, and secured with even pressure. Dressings which are too tight, or in which the pressure is uneven, may cause sloughing of a flap or graft which would otherwise be successful. All dressings around the mouth, nose, eyes or other orifices, should be changed frequently, as they are often soiled and infection may follow.

It is advantageous to inspect the flap frequently, because by loosening stitches where strangulation has developed, or by combating a small infection promptly, or evacuating fluid which has collected under the flap, it may be possible to turn what would otherwise be a failure into a success.

It is not advisable at this time to attempt even a brief outline of the dressings used by different surgeons, as their name is legion. The subject will be considered more fully under the section on the treatment of wounds.

INFECTIONS

Frequently in plastic surgery infections have to be dealt with. The wound may be infected when the case appears for treatment, or infection may develop during treatment, or after operation. The most dreaded of the ordinary infections is erysipelas. It is not uncommon

or erysipelas to develop after operations about the face, or it may occur at any time in unstable scars, or around chronic ulcers. The treatments suggested for erysipelas are very numerous. I will mention the only one which I have found to be uniformly successful. This method of treating erysipelas was first reported by Winckler. My attention was called to it by Col. W. B. Davis, M. C., U. S. Army, who has used it in his army work since 1893, in preference to any other treatment. The following mixture: tannic acid dram i; camphor drams ii; ether ounce i, is thoroughly shaken and filtered. This is painted over the affected parts with a camel's-hair brush every three hours, a whitish coating resulting. It is essential to paint at least one inch beyond the visible margin of the infection. The coating may be removed when necessary with soap and water for the purpose of observation after which the mixture may be reapplied as often as necessary. The fever will usually fall within 24 hours, and the disease be controlled within a few days.

Staphylococcus infections are quite common, especially about the mouth and chin, and may be combated with the mixture mentioned above, or by dressings wet with hot normal salt solution, or any other solution which does not damage the tissues.

When abscess forms following any sort of infection, the pus must be evacuated, and the cavity treated as in any ordinary case.

Infection with the *Bacillus Pyocyaneus* often occurs, and is especially noticeable in cases in which skin grafting has been done. Ordinarily it is of little consequence, and may be controlled with compresses saturated with 1-50 permanganate of potash, or, better still, with 1 per cent acetic acid solution.

MASSAGE AND PASSIVE MOTION

The intelligent use of massage is very important in plastic surgery. Before operation, scars may be made movable and the circulation of adjacent tissues improved. After operation, restoration of function is hastened by massage and passive motion, and areas that have been grafted may be loosened and the color and circulation of the flaps improved.

Massage of the operated area should be commenced about three weeks after operation, and if the healing is not quite complete, the surrounding skin should be kept in good condition by this means. The beneficial effect of massage in plastic and reconstructive surgery, both

before and after operation, seems to have been lost sight of to a large extent, and I wish to emphasize the importance of its systematic use.

ADVANTAGE OF KEEPING GRAPHIC RECORDS

It is impossible for either the surgeon or the patient to keep in mind the changes which take place during the progress of a case requiring a series of plastic and reconstructive operations, and for this reason it is of great importance that accurate graphic records be kept of the steps in the process.

The ideal graphic record is the life-size wax model painted in natural colors. The construction of these models requires an artist especially trained for the work, but up to this time the method has been unavailable for every day use.

For many years I have made it a rule to take series of photographs of these cases showing the condition before operation, and also the various stages of the reconstruction, and have found that a study of these unretouched photographic records is of great use in planning further steps, in the operative work, and in keeping permanent records.

Plaster casts are also most satisfactory, and should be utilized whenever possible; especially to show the original condition and progress made in the treatment of defects of the jaw, palate, and nose.

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CHAPTER III

PROSTHESIS

Ambroise Paré defined *prosthesis* as comprising all "methods and devices for supplying that which, from natural or accidental causes is lacking."

In plastic surgery prosthetic methods may be divided into *two groups*.

1. **External.**—Applied to those cases in which the prosthesis remains in communication with the outside air. 2. **Internal.**—Applied to those cases in which the prosthesis is buried, and has no communication with the outside air.

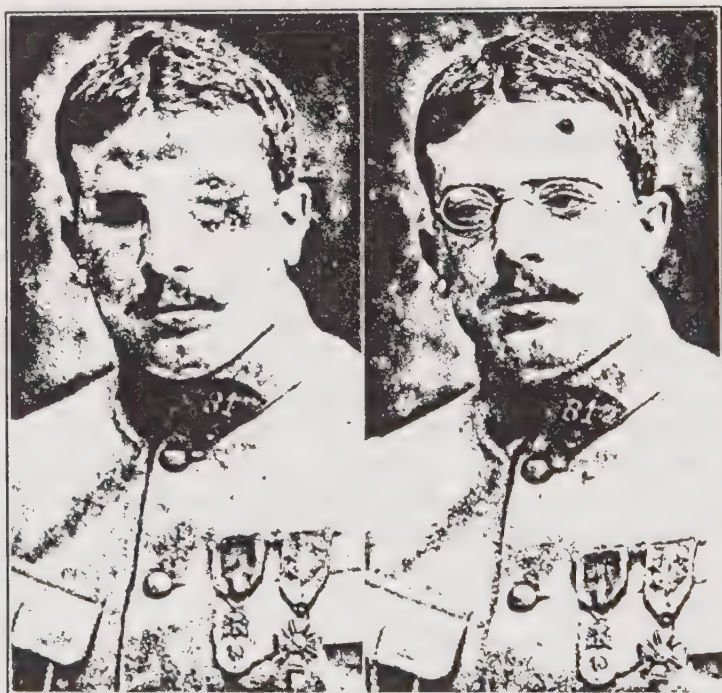
The success of *internal prosthesis* depends on absolute asepsis, and on the tolerance of the tissues for certain inorganic substances. Among the inorganic materials used for prosthetic apparatus, both external and internal, are the following: rubber (soft and vulcanized), gutta percha, gold, silver, platinum, tin, German silver, aluminum, copper and steel, glass, porcelain, ivory, celluloid, and paraffin.

External Prosthesis.—Those who have not learned by experience to appreciate the possibilities of plastic and reparative surgery are inclined to the opinion that all large facial defects should be treated with prosthetic apparatus. In some cases, especially those following the ravages of disease, a full or partial mask may be necessary, but in the great majority of traumatic cases it is better to reconstruct the destroyed parts of the face from the patient's own tissues.

Temporary prosthesis to prevent contracture is absolutely essential in many wounds of the face involving the bony framework.

Unquestionably an artist can construct an artificial nose or chin, which will be cosmetically more perfect than anything the surgeon may be able to build. At the present time, indeed, a number of sculptors and other artists are doing this work in England and France, and several are already working in this country (Figs. 55, 56 and 57). Their results are splendid as far as they go. I believe, however, that in the majority of cases this work should be only a temporary measure, used to cover the defect during the intervals in the process of construction, or to conceal the deformity until the patient can be placed

der the care of a skilled plastic surgeon. It is needless to say that the operative work on such extensive cases should be done only by the most experienced plastic surgeons, and it is far better for the patient to continue to wear his prosthetic apparatus than to be operated on by the first comer.



A

B

FIG. 55.—Mask for both eyes.

A. Patient without the mask.

B. The mask held in place by means of a spectacle frame.

This splendid mask and those following, were made by Mrs. Maynard Ladd, the Boston sculptor, while on duty in Paris (after the entrance of the United States into the war) under the auspices of the American Red Cross. Seventy masks were made in her studio. They are accurate reproductions of the missing parts modeled from photographs and measurements, and these masks are painted to match the surrounding skin. Masks of this type are of great value to patients beyond the aid of the plastic surgeon, and are most useful to patients in the intervals between reconstructive operations.

Capt. Whale, writing in September, 1917, says that in General Hospital 83, B.E.F. in France (which was established especially for plastic work) that only one man among all those treated has elected to go to England for a permanent mask prosthesis, rather than undergo a series of operations for the plastic repair of his defect.

Artificial noses are usually held on with spectacles, with springs.

or plugs placed in the nasal defect, or by a support attached to a dental plate, or to a tooth. Entire facial masks may be held in place with spectacles. In other instances with skin-lined loops or pockets, made by the surgeon to hold pegs attached to the mask. Combinations of these methods of securing masks, in addition to a strongly adhesive glue, are often used.

The nose alone may be made, or the nose and upper lip with mustache, or the chin, etc.



A B
FIG. 56.—Mask for the chin. (Mrs. Maynard Ladd.)

A. Patient without the mask.

B. The mask in place. The necessary dressings may be placed in the mask to absorb the saliva which is constantly dripping in some of these cases.

These prostheses must be carefully molded. Some are made of thin metal, others are of soft or hard rubber; papier mâché, or porcelain; others again of plastic paste or wax, all being colored to match the surrounding skin.

The technic of making a facial mask is rather complicated, the following being the process used by R. Tait McKenzie:

"1. The deformed part of the face, and the surrounding regions are lubricated with white vaseline, care being taken to fill the hair spaces in the eyelids, and the eyelashes. A quick-setting plaster of Paris is mixed and when it is of the consistency of thick cream, it is gently painted over the sound tissue with a soft brush,



FIG. 57.—Facial mask for the nose, chin and cheek. (*Mrs. Maynard Ladd.*)
 A. Patient without the mask. Note the blending of the edges of the mask with the tissues. Also note the natural appearance of the mustache.
 B. Patient with the mask in place.

until the surface is covered. Care must be taken to leave a breathing space at the nose and mouth, and to see that the face is not unnaturally drawn or wrinkled from nervousness. The plaster is strengthened and thickened, until it forms a sheet about one inch in thickness. When this has become set, as shown by the heat, it is carefully drawn off.

"2. This mold—the negative—is well soaped with green soap, oiled, and a cast—

the positive—is made and trimmed to the required shape and thickness. This serves as a record or original of the deformed face.

“3. From this model, a glue mold, or negative, is made.

“4. Several casts may now be made from this mold, and colored by water color, to match the plasteline, which is used in the next process.

“5. With the patient present, and by reference to photographs, the missing nose is modeled on one of these casts, great care being taken to imitate the surrounding surface texture and match it, especially at the edges. It is safer to model this in plasteline, over the plaster, rather than on a plasteline squeeze, as described later, if at all possible, because the hard plaster prevents one making the possible error of going too deep in modeling a hollow. Where a missing eye has to be reproduced, another process is necessary at this stage.

“6. A piece mold must be made from the cast (4). It is prepared with French chalk, and (6 A) a plasteline squeeze made. The sculptor then opens the eye by modeling it from life (6 B), because the eye was closed during the taking of the original mold over the face.

“7. A glue mold must then be made, from this plasteline cast of the remodeled eye, the sound one, and

“8. A cast is made from this, as in 4, the process going on as in 5.

“9. When the missing features have been modeled to the satisfaction of the sculptor and the patient, a glue mold is made of the restored face, from which

“10. A cast in wax is made and worked on or retouched, if necessary.

“11. The wax is now carefully coated with bronze powder, or plumbago, connected by copper wire with the cathode of a dry cell battery, and placed in a galvano deposit bath of sulphuric acid and sulphate of copper, between two copper plates connected with the anode. It is left there until a film of copper one thirty-second of an inch in thickness is deposited, a process lasting four or five hours. This is a process in which many failures are likely to occur, until a good deal of experience is gained.

“12. The wax is now melted out, and the metal mask trimmed and tried on. Every advantage must be taken of natural lines and wrinkles of the face, to hide the borders. The nostril holes are opened, as well as the eye slit, which masks the missing eye.

“13. The mask is then electroplated with silver by dipping in a solution of nitrate of silver, and

“14. When the eye has to be replaced, the artificial glass eye is matched with the good eye, or, better still, a blank one is painted to match, and then placed and held in place behind the open lids by wire clips, like the setting of a jewel in a ring. This fitting requires great care and patience.

“15. The mask is now given a coat of color, and the complexion is matched with great care, using oil colors with a wax medium. The success of this will depend entirely upon the artistic skill of the painter.

“16. When this is completed, a pair of spectacle frames, with heavy rims, are fitted on over the mask, and the nose piece is riveted through the copper, or soldered to hold them in place. When a cheek is replaced, it may be necessary to have a pin from the spectacle frame to the mask, to give the gentle pressure necessary to keep it in place.

"17. Eyebrows can be made with real hair, or by painting them, and eyelashes are best made, in the experience of Derwent Wood, of tin foil, cut in thin strips, colored and soldered to the edge of the eyelid. They can also be set with real hair in a groove of the lid, and held by wax."

As can be seen this process is quite complicated and should only be undertaken by one experienced in this sort of work (Figs. 58, 59 and 60).

A simpler method is that used by Pont. In cases which cannot be benefited by surgical procedures, he gives the patient a mold and plastic paste, so that he can make a new artificial nose whenever



FIG. 58.—Masking a facial deformity. Destruction of the face from the bridge of the nose to the lower jaw. (*Tait McKenzie.*)



FIG. 59.—The mask in place on the patient. This mask was constructed according to the directions found in the text. (*Tait McKenzie.*)

necessary. Of late he has furnished an apparatus for making wax models, and, if necessary, a new nose can be made each day and easily applied.

The artificial eye is of interest to the plastic surgeon, inasmuch as he is called upon at times (when the orbit is obliterated by scar tissue), to construct a cavity to contain the eye. On one or two occasions I have found it very difficult to make this cavity permanent.

Artificial ears are best made of a soft rubber composition which is flexible. The ear can be molded and colored to match exactly the intact organ. It is held in place with an adhesive paste, or with a skin loop, or with springs or wires.

As the reconstruction of a completely destroyed ear is extremely difficult from the standpoint of appearance, the permanent use of such a prosthesis is advisable. Pont also furnishes a carefully prepared mold and plastic paste to patients requiring artificial ears, so that they can change the prosthesis whenever necessary.

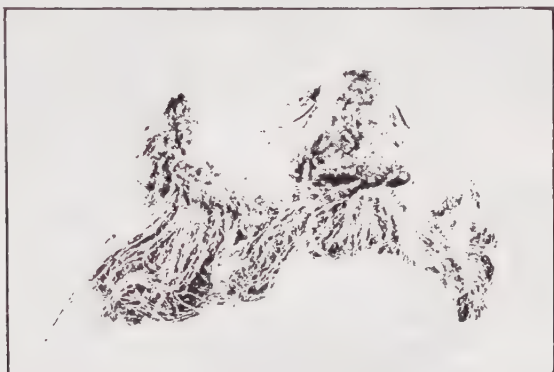


FIG. 60.—The mask itself has been colored to match the surrounding tissues. Mustache and whiskers are in place. This prosthesis is held on by means of spectacles. (*Tail McKenzie.*)

In those cases in which operative procedures are inadvisable for the repair of defects in the hard palate, obturators have been made to fill the defect. To these in some instances artificial vela have been attached, to take the place of the defective soft palate. More or less success, as far as improvement of speech is concerned, has been reported following the use of these obturators.



FIG. 61.—Method of holding an artificial nose in place by means of springs. (*Port.*) The plugs A and A' are on springs.

Internal Prosthesis.—In plastic surgery it is better to avoid the use of any inorganic material for a buried supporting framework. When inorganic material is used for internal prosthesis immediately under the skin, any injury may cause necrosis of the skin, and the formation of a sinus which will persist until the prosthesis is removed. When inserting prosthetic apparatus the incisions should be made so that the suture line is

not immediately over the prosthesis. It is advisable to cover the prosthesis with subcutaneous tissue before suturing the skin, or when it is placed in a tunnel to have the tunnel beneath the subcutaneous tissue.

Of the materials best tolerated by the tissues those most often used

are vulcanized rubber, or one of the metals, silver being probably the best for general use.

Celluloid is well tolerated by the tissues and causes no irritation. In experimental work I have found it unchanged after having been buried in muscle tissue for months. Monks in 1898 used it for building out a bridge in correcting saddle nose. G. S. Thompson writes enthusiastically on the surgical uses of celluloid buried in the tissues. He says that it should be molded to fit the place intended for it, and advises that it be freely perforated. He has used it in many situations with success (Fig. 63).

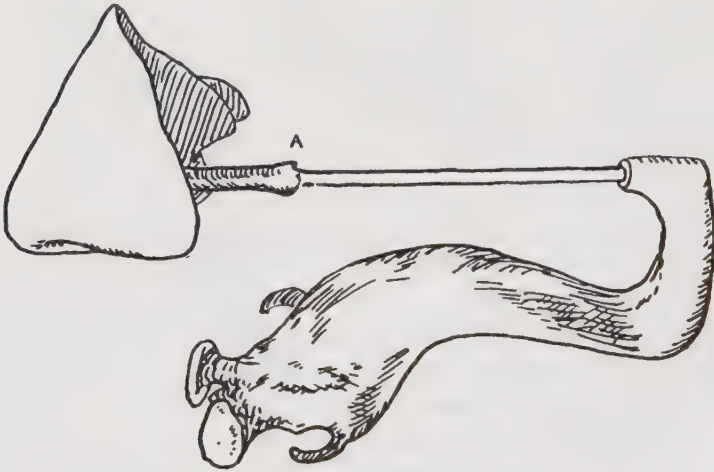


FIG. 62.—Method of holding an artificial nose in place by means of a dental plate. (*Port.*)
At A there is a bayonet lock.

C. Higgins used celluloid plates to support the skin and prevent recurrence of retraction in scars. Later he undermined the scars through a small incision and injected a semisolid mass of celluloid dissolved in acetone into the undermined tract. This was soon solidified and accomplished the same result. I have not tried the methods advocated by Higgins, but they seem unnecessary, if the surgical treatment of depressed scars is understood.

SUBCUTANEOUS HYDROCARBON PROSTHESIS

The injection of paraffin has been advocated by a number of workers and is principally used for the correction of certain deformities about the face, shoulders and breast.

Gersuny in Vienna, in 1899, injected vaselin subcutaneously for the correction of a saddle nose. Delanger about the same time injected spermaceti for the same purpose. Vaseline with a melting point

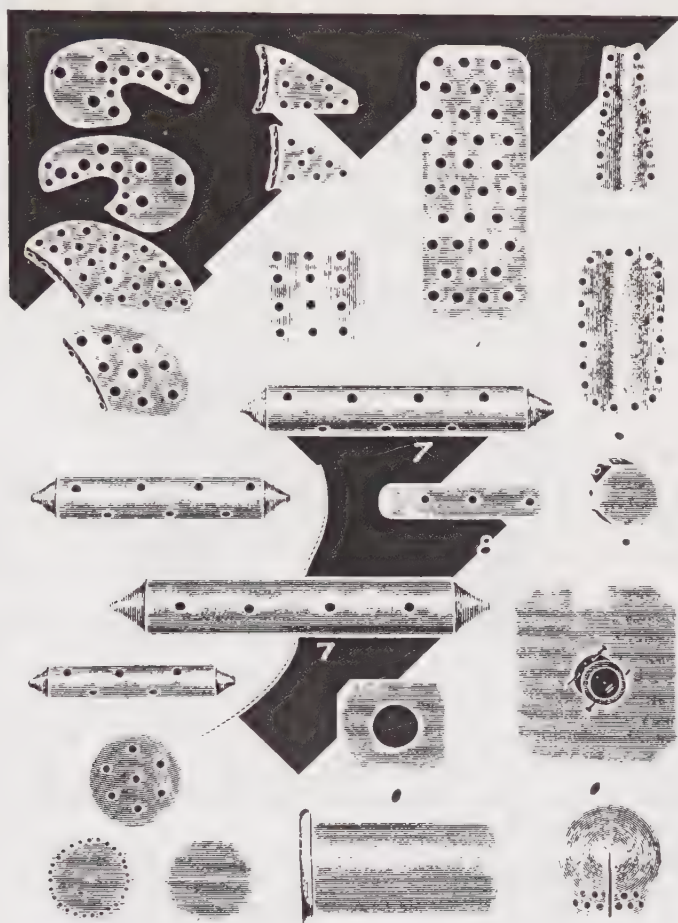


FIG. 63.—Celluloid, molded and cut in various shapes, for implantation into different regions. (About one-half size.) (Thompson.)

1, Filigrees for inguinal hernia; 2, filigrees for femoral hernia; 3, filigrees for umbilical hernia; 4, filigrees for post-operative hernia; 5, nasal bridge; 6, bridge for spina bifida. 7, celluloid pegs for bone fractures; 8, celluloid plate; 9, joint cap for covering bone in arthrodesis (rough representation); 10, flanges for drainage tubes; 11, skull plates (inner without perforation, except at edges); 11a, skull plate (outer); 12, dust-proof cover for surgical bottles; 13, molded cap for bone end.

of 33° to 39°C . (91.4° to 102.2°F .) was found to be too soft, and slow absorption, or diffusion often took place. Embolism also occasionally occurred.

A mixture of vaselin and paraffin was then tried, having a melting point between 42° and 46°C . (107.6° and 114.8°F). Eckstein in 1901 used pure paraffin with a melting point of 60°C . (140°F), instead of the vaselin-paraffin mixture. It has since been found that paraffin with a melting point of about 52°C . (125.6°F .) is to be preferred.

In a number of cases in which paraffin was injected into the tissue of the nose, there has occurred an embolism in the central artery of the retina, which caused immediate and permanent blindness. Pulmonary embolism has occurred, and thrombophlebitis has also followed these injections. Connell has tabulated a number of untoward results following the injection of paraffin, and Kolle has added to the list which follows:

Untoward Results

1. Toxic absorption.
2. Marked inflammatory reaction.
3. Loss of tissue, due to infection and abscess formation.
4. Pressure necrosis, caused by hyperinjection.
5. Sloughing of tissue as a result of the heat of the material injected.
6. Sloughing due to injection into very dense or inelastic structures, or where scar tissue is firmly attached to the underlying and adjacent parts.
7. Subinjection of too small an amount of paraffin with an insufficient correction of the deformity.
8. Hyperinjection with overcorrection of deformity.
9. Air embolism.
10. Paraffin embolism.
11. Primary diffusion or extension of paraffin (when first introduced) into adjacent normal structures.
12. Interference with muscular action of the nose.
13. Escape of paraffin after the withdrawal of the needle.
14. Solidification of the paraffin in the needle, which renders the injection difficult and causes injudicious expedition on the part of the operator.
15. Absorption or disintegration of the paraffin.
16. The difficulty of procuring paraffin at the proper melting point.
17. Hypersensitiveness of the skin over the injected area.
18. Redness of the skin over the injected area.
19. Secondary diffusion of the injected mass.
20. Hyperplasia of the connective tissue following the organization of the injected matter.

21. A yellow appearance and thickening of the skin after organization of the injected mass.

22. The breaking down of tissue and a resulting abscess due to the pressure of the injected mass upon the adjacent tissue after the injection has become organized.

Some authors say that the injected paraffin is encapsulated like any other foreign body. Others claim that the mass is first surrounded by a connective tissue wall and that fibrous bands are then formed which penetrate the mass. Eventually the paraffin is said to be absorbed and in its place is left a connective tissue mass which is hard and resistant to the touch.

In my operative work on these cases I have found that both conditions are present even after several years have elapsed. The connective



FIG. 64.—Paraffinoma.

Note the thickening of the tissues of the nose, cheeks and lips, and the obliteration of all the natural lines. The mucous membrane was also involved in this case, and the patient was unable to masticate without biting the projecting folds. Paraffin had been injected two years previously, several times for the purpose of eradicating wrinkles. The skin was purplish-red and very dense and hard.

tissue mass is hard enough to blunt the edge of a scalpel, and in cutting into this tissue I often find that flakes of paraffin are floated up in the blood. These tissues are difficult to handle surgically.

There may be a large number of patients who have been permanently benefited by the injection of paraffin, but a glance at the list of untoward results is enough to discourage the most daring surgeon who has any regard for the safety of his patient. The terrible *uncorrectable* deformities produced by the development of paraffinoma months after apparently successful injection of paraffin, have only to be seen once, to further discourage any one desiring to use this method (Fig. 64).

Occasionally the tumor masses of paraffinoma show themselves under the mucous membrane of the cheeks and lips and project into

the mouth, so that it is difficult for the victim to chew without biting the mucous membrane.

The technic for the injection of paraffin is simple and the injections can be given, after a little practice, by anyone who is able to purchase the equipment. The immediate results, when none of the untoward happenings occur, are at first very gratifying to the patient. Nevertheless, the paraffin frequently shifts its position, and gradually trickles down the tissue planes, or the infiltrated tissues may thicken and cause deformities which are infinitely worse than the original defect.

The injection of paraffin is the sheet anchor of the "quack" facial specialist.

I am sure that all those who have seen the disastrous effects following paraffin injections will agree with me that this method of internal prosthesis is a poor surgical procedure.

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CHAPTER IV

THE TRANSPLANTATION OF SKIN

Skin grafting and plastic surgery are very closely linked together. There is rarely an extensive plastic operation done in which, at some stage, it is not necessary to graft skin. The plastic surgeon should be thoroughly skilled in the technic and be able to utilize any type of graft which may be necessary. I shall consider in detail only the technic of those methods which have proved satisfactory to me.

In order to avoid repetition the various procedures required in all the methods will be described before the technic of the methods themselves is discussed.

GENERAL CONSIDERATIONS

Source of Grafts.—Grafts may be obtained from almost any portion of the skin. The region from which it is taken has little if any effect on the success or failure of the graft.

It was at one time thought that skin taken from a part corresponding exactly with the defect would heal better, but this has been disproved. Von Langenbeck says: "It was thought in former times, especially when science was governed by natural philosophy, that even after a piece of skin had grown firmly to its new owner, its nutrition depended on the state of health of its original possessor." Fortunately, we now know better.

Autografts should be used in preference to all others when available. We seldom find a patient who cannot supply skin for one of the types of grafts, and even if complete grafting cannot be done at once, partial grafting may be done and the work completed when warranted by the condition of the patient.

Isografts.—There is much difference of opinion as to the advisability of utilizing isografts, and many surgeons insist that only autografts should be used. Of course autografts are more likely to succeed, but I feel convinced that, when it is not possible to obtain autografts, isografts are well worth trying, and that good lasting results may be secured, if the grafts are obtained and transplanted with the proper

technic. Nevertheless, wounds have come under my observation on which no isografts would take (even after repeated trials from many donors), whereas autografts on the same wounds brought about prompt healing.

In the study of the series of 550 cases of skin grafting at the Johns Hopkins Hospital, published in 1909, I reported 40 successful cases of isografting. These results were taken from the hospital history notes, but I do not now believe that the percentage of permanent takes was as large as these notes had led me to believe.

I have thought for some time that the success or failure of isografts may be dependent on the similarity or dissimilarity of blood groups of the host and donor. This point has been proved by Masson, at the Mayo Clinic, who reports excellent results with isografts, and has had the opportunity of testing the blood of the donor and of the recipient for agglutination. He has never had a successful result in isografting in a case in which the red blood corpuscles of the donor were agglutinated by the serum of the patient. The results in all other cases in which the blood did not agglutinate, were most satisfactory. Shawan has also reported similar results in grafting war wounds, in which the principle of blood grouping was applied. These findings are of the greatest importance, inasmuch as by means of a simple blood test the likelihood of a successful isografting can be forecast with a fair degree of certainty.

Care must be taken when isografting is contemplated, not to transmit disease to a healthy person, as cases have been reported in which small-pox, syphilis, and tuberculosis have been transmitted in this manner.

R. Minervini reported the successful use of whole-thickness grafts obtained from the skin of babies who had died during delivery or a few hours after birth. This material, if available, is undoubtedly most satisfactory for successful transplantation.

Isografts may be obtained in the operating room (while performing any clean operation) by removing an elliptic-shaped piece of skin, instead of making a linear incision. This wound can be closed as easily as the linear incision. *Permission to remove this skin should always be obtained from the patient in advance*, and all necessary tests should be made to safeguard against the transmission of disease to the patient to be grafted. I have successfully transplanted skin obtained in this way in a number of cases.

Zöografts.—Zöografting has been tried for years, and successes have been reported. The grafts have been taken from many species,

Among others from the inner surface of the wing of a pullet, skin from pigeons, from young puppies, from guinea-pigs, rats and rabbits. Martoux and Dubousquet-Laborderie successfully implanted the skin of frogs on a granulating surface in man. The pigment disappeared in 10 days, and the grafts rapidly changed in character, taking on more and more the resemblance to human skin. Cannaday grafted with fair success the skin of a common water lizard.

Bits of muscle have been applied to granulating wounds, and more rapid epidermization was claimed. The lining membrane of a hen's egg, cut in strips and applied with the shell surface outward, has also been used. Riven and also Browning successfully transplanted the superficial layers of the skin of a young pig, and it was noted that the pigment rapidly disappeared. Flegenheimer transplanted whole-thickness grafts, with good results, from the belly of a young pig and stated that fine hair grew on the graft.

Venable reported his studies with Ollier-Thiersch grafts of pig skin in the treatment of extensive burns and stated that he obtained from 35 to 100 per cent of takes.

Miles transplanted the skin of dogs, rabbits, kittens and frogs. He was most successful with grafts from dogs, and least successful with frog skin. A young animal was always selected. It was killed and after the skin of the abdomen had been thoroughly cleansed, whole-thickness grafts without the subcutaneous fat were removed. These were placed in sterile boric acid solution, trimmed to fit the wound, and pressed in on healthy undisturbed granulations. He quotes four successful cases, and noted that the pigment rapidly disappeared, and that no hair, sweat or sebaceous matter could be found in the skin.

My own experience is that these grafts take readily, and receive their blood supply as promptly as ordinary grafts. They also have the same power of stimulating epithelial growth from the edges when placed on granulating wounds, as do other grafts. Nevertheless, in every case which has come under my observation these grafts, after doing well and often when the wound was entirely healed, suddenly and with no apparent cause have begun to melt away, and have soon disappeared.

ANAPHYLACTIC SYMPTOMS have been reported in several cases following the use of isografts, and egg membrane grafts, but in a somewhat wide experience I have never observed such symptoms.

Sponge grafting was elaborated by Hamilton of Edinburgh. The granulating wound was accurately covered with thin sections of a fine

sponge previously prepared, and these sections were replaced as the granulations grew. The wound was dressed with protective and wet carbolic acid (1-20) gauze. Healing was very slow. This method was soon abandoned as an aid in hastening epithelization. I have found it useful in stimulating sluggish granulations, as is also the network of catgut suggested by Neuhäuser.

Transplantation of Fetal Membranes.—In 1909 and 1910 at the suggestion of W. L. Thornton, then a third year student in the Johns Hopkins Medical School, I tried grafting pieces of the lining of the amniotic sac, but was unable to secure permanent results.

In 1913, Sabella and Stern reported several cases in which they had successfully transplanted amniotic membrane. They were able to preserve this tissue for some time by the Carrel technic (petrolatum and cold storage). They insist upon the importance of placing the lining or glistening side of the membrane next to the wound. Flexible paraffin, or moist salt gauze dressings were used.

Ulcers, burns and traumatic denudations were grafted successfully with this material, but the final results after a considerable period of time had elapsed were not given. Since the publication of these reports little has been heard of this method.

The material is abundant in every hospital with an obstetrical department, and would therefore be easily available. Theoretically this tissue should be transplantable, as it is derived from the ectoderm and is composed of embryonic skin elements. There is considerable doubt in my mind as to the permanent results obtainable from the use of fetal membranes.

Surface on Which Grafts May be Placed.—All types of grafts may be placed on fresh wounds and also on healthy granulating surfaces. When the wound is fresh, the grafts will live when placed on fat, fascia, tendon, muscle, perichondrium or bone.

When placed on granulating surfaces success depends to a large extent on the condition of the wound, and it is most important that the granulations be clean, firm, rose-pink in color, and not exuberant. In addition the bacterial count from the wound secretion should be negative, and time is saved in the end by careful attention to this point.

The advantages of placing grafts on undisturbed granulations are that (1) there is no pain during the preparation of the wound, or application of the graft, (2) there is no loss of blood—an important point in patients already much depleted, (3) there is little likelihood of blood or serum collecting under the grafts, (4) there is no danger of

lighting up infection, and blood vessels enter the grafts much sooner if the granulations are not removed.

I have been able to obtain bleeding by cutting into a whole thickness graft 84 hours after transplantation upon a healthy granulating surface, whereas the earliest record of bleeding in a similar graft on a fresh wound is 6 days (Krause).

Preparation of the Granulating Area for Grafting.—In order to put a granulating surface into the proper condition for grafting, various methods may be employed. Among others may be mentioned painting with tincture of iodine, touching frequently with nitrate of silver (weak solutions for stimulation, saturated solutions or stick for cauterization), applying balsam of Peru (either pure or in castor oil, 1 to 3), gauze wet with boric acid, or salt solution, or a solution of chloral hydrate 2 grains to the ounce of water. I have found it very satisfactory after cauterizing thoroughly with pure carbolic acid, to remove the granulations down to the firm base, then dress with dry gauze over which is placed sterile boric acid ointment. If this is done it will be found that within 48 hours the new granulations will be ready for grafting.

The development of the use of Dakin's hypochlorite solution used either by Carrel's technic or on compresses, for rendering a granulating surface sterile is a great advance in the preparation of wounds for grafting. The progress of disinfection by this method can be followed by bacterial counts and gives us absolute control as to the condition of the surface. Dichloramin-T in from 5-7.5 per cent strength is also useful for the same purpose.

Method of Preparing Healthy Granulations to Receive Grafts.—On the day preceding the operation all secretions and crusts are removed and the granulations are dressed with moist boric acid or salt solution gauze. The dressings are removed at the time of operation and the wound washed carefully so as not to cause bleeding with gauze sponges dipped in warm salt solution. The surface is thoroughly dried, a pad of dry gauze is placed over the wound, pressed down firmly on the granulations and removed only when the operator is ready to apply the grafts. It is most important that the surface to be grafted should be perfectly dry, because the grafts adhere much better to a dry surface and are less liable to be subsequently displaced. If Dakin's solution has been used in the preparation, it is only necessary to dry the granulating surface.¹

¹ R. C. Bryan, in 1917, speaking of the Carrel treatment with Dakin's solution, says: "It is interesting to note that there is no skin grafting done upon the large raw surfaces.

Anesthesia.—All types of grafts may be cut under local anesthesia, either by infiltration or nerve blocking; the infiltration seems to have no deterrent effect on the healing of the grafts.

Small deep grafts are usually applied to undisturbed granulations, and general anesthesia is unnecessary, unless the patient is a young child or is in a highly nervous condition.

A general anesthetic is often necessary in the extensive operative procedures resulting in the fresh wound to be grafted. Advantage is always taken of this anesthetic to cut the Ollier-Thiersch or whole thickness grafts, which are the types ordinarily used to cover large fresh wounds.

Rose cites cases in which he cut grafts 2.5 to 5. cm. (1 to 2 inches) wide and as long as necessary, without the use of an anesthetic. Possibly this can be done in a limited number of cases. Torrance freezes the area to be cut with ethyl chloride, he then cuts Ollier-Thiersch grafts and transplants successfully. Foote infiltrates small areas with salt solution, and then cuts from these areas.

I have cut Ollier-Thiersch grafts after freezing or using the ether spray with little or no discomfort to the patient.

Nystrom in January, 1909, advised that whole thickness and Ollier-Thiersch grafts be cut after anesthetizing the external cutaneous nerve (of the thigh) through the skin by means of 4. or 5. c.c. of a 1 per cent solution of novocain, to which was added 5 drops of 1 to 1000 adrenalin chloride solution for each 10. c.c. This mixture was injected just to the inner side of the anterior-superior iliac spine, then below it at various depths in the subcutaneous tissues; some of the fluid being deposited under the fascia lata but not too deeply into the muscles. Blocking of the external cutaneous nerve was first practised at the Johns Hopkins Hospital, over 15 years before Nystrom's report, for the purpose of cutting grafts without pain from the area supplied by this nerve, and this method is still occasionally used.

THE AREA FROM WHICH THE GRAFTS ARE TO BE CUT may be prepared as for any other operation.

Although grafting at first would apparently hasten recovery, by mathematical equation it has been demonstrated to delay repair, so that the surgeons have found out by experience that the application of skin was unnecessary, and in every instance was contraindicated."

Evidently this viewpoint has changed, since at the Rockefeller War Demonstration Hospital, every surface wound of any size that has been rendered aseptic by Carrel's technic with Dakin's solution, is skin grafted, and by this means the time of healing is very much shortened.

Dressing of the Area From Which the Graft is Cut. All sorts of dressings have been tried. Sterile boric-acid ointment spread on rubber protective, or silver foil covered with rubber protective, are comfortable and efficient for the wounds resulting from the cutting of small deep grafts and Ollier-Thiersch grafts. Both of these dressings should extend some distance beyond the margins of the wound, and be held in place with strips of adhesive plaster, over which is placed dry sterile gauze and a bandage. One of the flexible paraffin mixtures, applied as to a burn, is also satisfactory.

The wound from which a graft of whole-thickness skin is taken should be dressed as any ordinary sutured wound.

SMALL DEEP SKIN GRAFTS

The hastening of the healing of granulating wounds by the use of small detached bits of skin was first demonstrated by J.-L. Reverdin.

Grafts obtained by Reverdin's method are usually thought of as pure epidermic grafts, and in his articles Reverdin always spoke of them as *greffe épidermique*; but in his exhaustive paper on the subject published in 1872, he says in part, "The title 'epidermic' grafts is not absolutely correct, as the transplanted bit is composed of the whole epidermis, and a very little of the dermis."

Reverdin also said that if the epidermis alone could be transplanted the same result would be obtained as when a part of the dermis was included. This, of course, is true in so far as the epithelium is concerned, but it has been my experience in a large number of cases that the grafts which are somewhat deeper and contain more of the true skin, give a more stable healing, and that the final result shows more of the normal skin-characteristics than when the thinner grafts are used. I have called these grafts *small deep grafts* (Fig. 65).

As there is little difference except in thickness between the small deep grafts and Reverdin grafts, the following methods of preparation will be found applicable for either type.

Autografts are almost uniformly successful when placed on a granulating surface that is in proper condition. It is far easier to cut them from a region such as the front of the thigh where the skin is quite taut, than from places where it is lax, as for instance on the abdomen.

A large number of these grafts can be obtained from a comparatively small area, thus making it possible to use small grafts on extensive

wounds without any severe tax on an ill patient.¹ In a number of instances I have applied several hundred of these grafts at a single operation.

Technic.—The simplest way to obtain these grafts is to pick up a bit of the epidermis with a straight intestinal needle held in an artery clamp.² It is raised so that a little cone is formed and the base of the

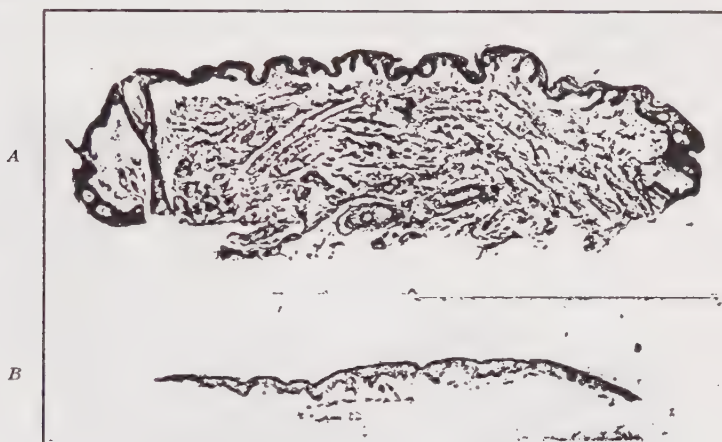


FIG. 65.—Photomicrographs of the same magnification showing the comparative thickness of a small deep graft and a Reverdin graft.

A. A small deep graft cut to include a considerable thickness of the true skin; in the section the edges of the graft are curled inward.

B. A Reverdin graft cut to include as little of the dermis as possible; there is a thin layer of the dermis throughout, which is thickest in the center.

cone is cut through by depressing the blade of the knife.³ (The thinner Reverdin grafts may be obtained by cutting off the tip of the cone). The graft, still on the needle, is transferred to the wound with the raw surface downward (Fig. 66). The grafts are placed in rows, a space

¹ I have in mind an illustrative case. A child, aged 12, was severely burned over the pelvis, thighs and legs. She came under my care nearly a year after the accident, during which period she had been repeatedly grafted without success. Her condition was desperate. She was delirious, extremely emaciated and generally depleted by the pain and by the long-standing suppurating wounds. As a last resort the wounds were grafted with small deep autografts, which were successful, and within a few days the change in her condition for the better was astonishing. A prompt recovery followed. No other type of autograft could have been successful in this case, on account of the condition of the granulations.

² Agnew, D. H., first suggested the use of the needle to raise the bit of skin to be cut in obtaining Reverdin grafts.

³ The use of forceps and scissors in obtaining small grafts is not desirable, as the skin is thereby traumatized unnecessarily.

of 0.5 cm. ($\frac{1}{2}$ inch) being left between each graft.¹ When two rows are in place a strip of dry sterile rubber protective, about 2.5 cm. (1 inch) wide, in which V-shaped cuts have been made, is applied over them, so that the lower edge of the protective just covers the row of grafts last applied. Then the protective is pressed down over the grafts firmly with a gauze pledget and the edges of the grafts will uncurl and spread out evenly on the wound. The next row of grafts is placed close to the edge of the protective, and after two or three rows have been applied they are covered with a second strip of protective, which overlaps the first piece



FIG. 66.—Method of cutting Reverdin and small deep grafts.

1. A straight intestinal needle, held in an artery clamp, with its point engaged in the skin. A little cone of skin is raised.
2. The scalpel cutting through the base of the cone.
3. Placing the graft on the granulating surface. A large opened-out safety pin is very useful in detaching the grafts from the needle. In this photograph none of the grafts have been pressed down on the wound, and the edges are still curled under.

about one-half its width. The protective is pressed down firmly, and the procedure is continued in this manner until the whole wound, or the part selected, is covered.² The ends of the protective strips which extend beyond the wound edges may be fastened securely to the normal skin with a few drops of chloroform. Moist salt solution gauze over the protective strips secured by a bandage affords a satisfactory dressing.³ Paraffined mosquito netting immediately over the grafts, and

¹ The grafts will spread over a considerably larger area, but I believe that more stable healing is produced when the grafts are placed quite close together, than when they are placed with greater intervals between.

² The overlapping strips of protective and the V-shaped cuts allow the escape of any secretions from the wound into the overlying dressings.

³ C. A. Porter of Boston uses crepe lisse and collodion to hold grafts on small wounds.

then boric-acid ointment is also a useful dressing. The part should be immobilized as far as possible.

The grafts are either round or irregularly oval. They vary between 0.2 and 0.4 cm. (about $\frac{1}{12}$ and $\frac{1}{6}$ inch) in diameter, and should seldom be larger than 0.4 cm. (about $\frac{1}{6}$ inch). They are thickest in the center and taper off toward the edges. With a sharp knife the size, contour and depth can be judged quite accurately (Fig. 67).

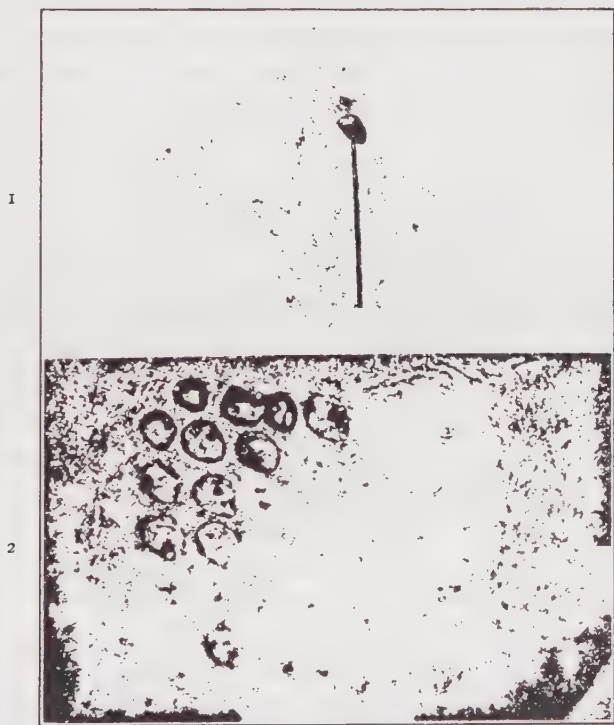


FIG. 67.—1. The actual size of a small deep graft with its edges curled under. When this graft is pressed down on a wound the edges flatten out, thus making the graft about one-third larger.

2. The punched out defects left after cutting the grafts. Some are filling up with blood in spite of the epinephrin in the local anesthetic. Note the depth of the pits and the rim of undisturbed skin between them.

The wounds left by the removal of the grafts have the appearance of small pits punched in the skin, there being a rim of untouched epithelium between the pits. Fat may be seen in the bottom of some of the pits, which shows that a considerable depth of the skin is used.

There is more bleeding following the removal of these small deep grafts than when the Reverdin grafts are cut, and the resulting scars are also somewhat more pronounced.

Sometimes when the grafts are small and the skin blood stained, it is difficult to determine which is the raw surface. This difficulty is obviated when the grafts are obtained from a negro or when the iodine technic is employed.

When a large number of these grafts are necessary the process is very tedious, but this may be mitigated to a certain extent by having two men to cut the grafts, while a third places them, or vice versa, depending upon conditions.

A RACK FOR FACILITATING THE HANDLING OF SMALL DEEP SKIN GRAFTS.—As a rule there are no conveniences for stacking the artery

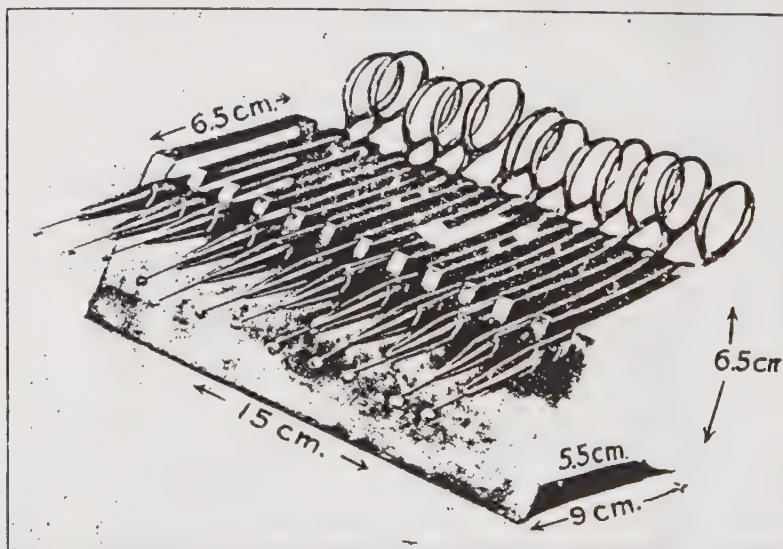


FIG. 68.—Rack for facilitating the handling of small deep skin grafts. In the illustration the rack is tilted in order to show each slot. Note the dimensions. The rack is filled with Halsted clamps, each carrying a straight intestinal needle. The handles of the clamps are on the highest side of the rack. The slope is sufficient to prevent them from sliding, and thus brushing off the grafts, which can be seen on each needle.

clamps that hold the needles and grafts. In consequence an instrument is often upset or slips, the graft is brushed off, and is lost or much time is wasted in trying to pick it up. In order to eliminate this inconvenience I have devised a slotted metal rack to hold the clamps. It is made of 18-gage sheet copper, so bent that the end view shows the form of a trapezium. The longest side of this figure is used as the base, and to facilitate cleaning is open, except for three strips which are necessary to brace it. The twelve slots are made on the side opposite the base, and each is wide enough to admit the ordinary Halsted artery clamp (Fig. 68).

The rack can be used with great comfort when one man is cutting and also placing the grafts. The twelve slots are filled, the rack is then moved close to the wound to be grafted, and all these grafts are then applied. This maneuver can be repeated as often as necessary, and it can be readily seen that an enormous amount of labor is saved, as without this frame each graft would have to be placed on the wound as it was cut.

When a large wound is being grafted with small deep grafts, the method of procedure is as follows—The rack, with its highest side toward the operator, is placed in a position convenient for him. Then as the grafts are cut the clamps are dropped into the slots, and when the cutting is faster than the placing, the clamps are moved along progressively toward the placer, by the nurse, so that those grafts first cut will be applied first.

POST-OPERATIVE TREATMENT.—As a rule the patient should ordinarily be kept in bed for a longer or shorter period, depending on the size and location of the grafted area. Nevertheless, I have had considerable success in grafting ulcers in the Out-patient Department with small deep grafts and have allowed the patients to go about their business.

The part should be immobilized and protected from injury. If the grafts have been placed on a *granulating surface* the dressings should be removed not later than the second or third day and any wound secretions carefully mopped or washed off with a gentle irrigation of normal salt solution. If the grafts are placed on a *fresh wound* the first dressing may be delayed until the fifth or sixth day (Fig. 69).

It is possible after 48 hours to tell whether or not the grafts have been successful, and in many instances a narrow ring of new epithelial growth can be seen surrounding each graft. Should the granulations between the grafts be unhealthy, compresses wet with Dakin's solution may be employed without injury after the fourth day, but I do not believe that the grafts spread as rapidly as when milder measures are used. My experience has been that this solution is injurious before the blood supply to the grafts is assured.

Later some bland ointment on old linen is applied, and if after a day or two the epithelial growth from the grafts is not as vigorous as desired, it is well to alternate the bland ointment with scarlet red (8 per cent, in either petrolatum, or in zinc ointment) or to use some other epithelial stimulant.

The surface from which the grafts are taken should be dressed in three or four days if protective or paraffin is used and the area dusted

with a dry powder. If silver foil is used, it should not be disturbed for ten days, but after this time all dressings may ordinarily be removed.

As soon as the new epithelium has filled the gaps between the grafts and joined the epithelium from the wound edges, the grafted area may be dressed with a dry powder, such as zinc stearate, and exposed to the air. I have not found the open treatment of these or any other grafts immediately after application to be satisfactory; although exposure for an hour or two at a time, to the light and air is advantageous after the second or third day.

The grafted area should be protected from injury for several weeks. Gentle massage is advisable after about three weeks, and should be

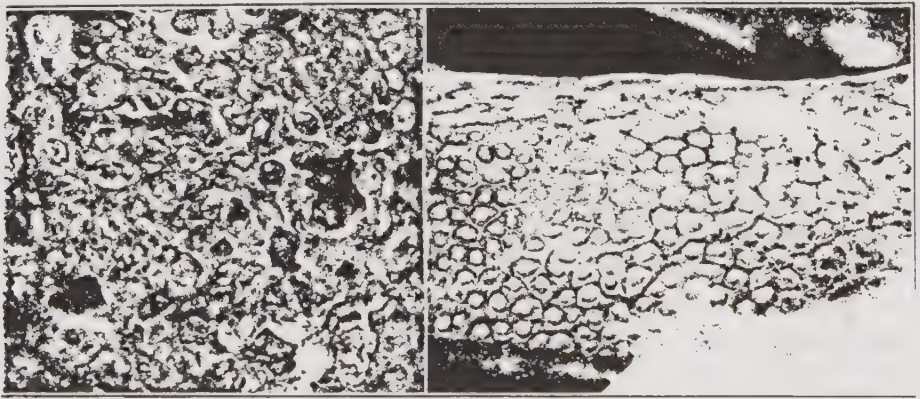


FIG. 69.—Small deep grafts.

1. A portion of a granulating wound ten days after grafting with small deep grafts. Note the grafts in the center of a halo of new epithelium, which is spreading around each one of them. Some have already joined.

2. The same area two months later. The grafts themselves are of normal-appearing skin, which is soft and flexible. Between the grafts is scar tissue which is slightly depressed.

continued until the grafted area is as freely movable as the normal skin around it.

There is marked desquamation of the grafted surface when it dries out, especially between the grafts, which is evidently due to epithelial over-production, but this scaliness can easily be controlled by the application of olive oil, or cocoa butter.

UNTOWARD POSSIBILITIES.—There are certain untoward possibilities which must be considered. On account of the simplicity of the operative procedure, we are accustomed to regard the use of small grafts as attended with no danger and with but few bad results. Aside from contraction, which may occur, we must consider the danger of carrying

infection from the granulating surface to the wounds from which the grafts are cut. It is a difficult matter to convey a graft on a needle or



FIG. 70.—Chronic ulcer of the groin, following the excision of tubercular (?) glands. Duration two years.

1. Note the position of the ulcer and the scar above it, as the ulcer gradually healed above and extended below.

2. The same ulcer eight months later, after excision with the cautery. Note the position, now on the level with the anus, healing having taken place above.

3. Ulcer on the thigh following an infection from the parent ulcer in the area from which small deep grafts were removed.

4. The scar following healing of the ulcer shown in 1 and 2. This was finally accomplished by frequent excisions with the cautery and numerous graftings. This photograph was taken just one year after the first picture in this group.

None of the tests tried revealed the cause of the great resistance of this ulcer to treatment. There has been no recurrence during the six years which have elapsed since discharge from the hospital.

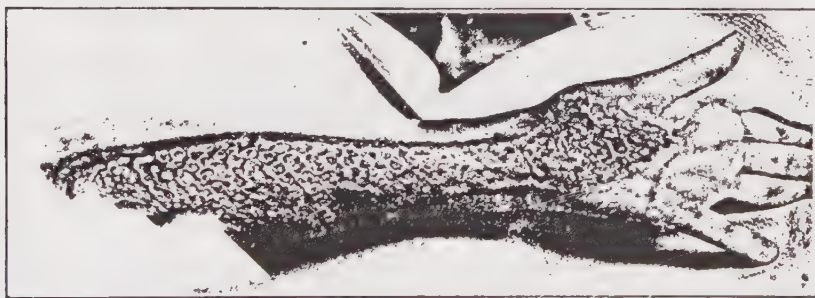


FIG. 71.—Result of small deep grafting on a third-degree burn of the forearm and wrist of a negro woman. The grafts can be seen in little pits surrounded by a keloid-like growth. The tendency to contracture in this situation is quite marked and a profile view shows flexion of the wrist. The advisability of using small deep grafts on an ulcer of this extent and in this situation on a negro is very questionable.

any other instrument, to a granulating wound without occasionally touching the granulations with the instrument. In order to avoid this chance of contamination, it is best either to use a fresh needle for each

raft or to have several needles, so that one can be flamed while the other is in use¹ (Fig. 70).

Another disagreeable occurrence is the formation of keloid. Occasionally a massive keloid will form in the grafted area, and the grafts themselves can be seen at the bottom of little depressions in the keloid (Fig. 71). This growth would probably occur in these wounds whether

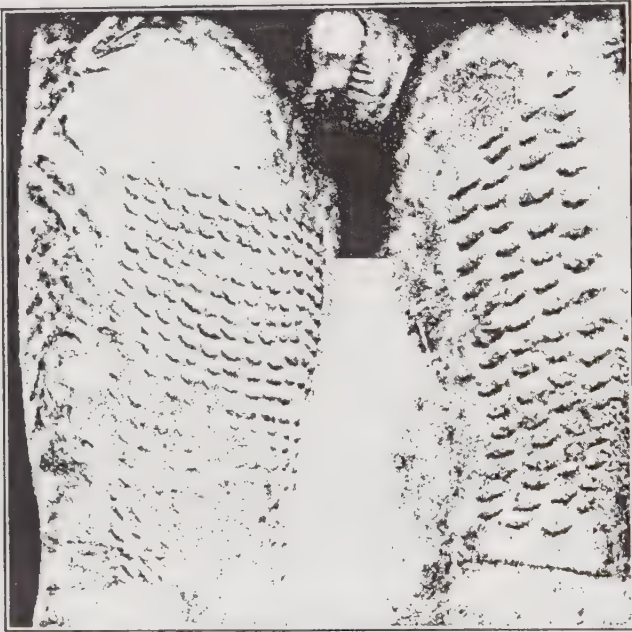


FIG. 72.—Small deep grafts. The development of keloid on the thigh in the wounds from which small deep grafts were cut. All of the grafts taken from the right thigh were cut at one operation and all on the left thigh were cut at another time. The size of the grafts taken from the right thigh are more nearly correct (although considerably larger than necessary) than those from the left, which are much too large.

they were grafted or not. Again, keloid may develop in the scars of the wounds from which the grafts are taken (Fig. 72).

Comments.—The age of the patient has apparently little effect on the healing of small grafts which will often succeed on granulating

¹ The importance of this point was impressed on me by the following incident: A very resistant ulcer of the groin of long standing, the etiology of which could not be definitely determined, was grafted with small grafts during my absence. The wounds from which the grafts were taken on the thigh became infected, and when I was called to see the patient a week afterward, an ulcer similar to that in the groin had developed. This ulcer also resisted every method of treatment used, and it was finally necessary to excise the entire area with a liberal margin. The defect, which was 11 cm. ($4\frac{2}{5}$ in.) in diameter, and down to the deep fascia, was immediately grafted with an Ollier-Thiersch graft and healed promptly.

surfaces under conditions in which no other type of graft could live. There is almost invariably a marked stimulation of the epithelium of the wound edges, following the application of these grafts, even though the grafts be unsuccessful, and successive grafts give successive stimula-



FIG. 73.—Ulcer of the buttock, thigh and leg following a burn. Duration thirteen months.

1 and 2. Condition when the child came under my care. Note the partial contracture of the knee. After preparing the granulations the wounds were entirely healed four weeks after grafting with small deep grafts. The knee was then straightened by a plastic operation.

3. Photograph taken eighteen months later. The scar is soft and movable and there is no tendency to recontracture. Function of the part is perfect.

tion. Under favorable conditions epithelium from a single graft 0.4 cm (about $\frac{1}{6}$ inch) in diameter will spread over an area 2.5 cm. (1 inch) in diameter, but a more stable healing follows if the grafts are placed much closer together (0.5 cm. = $\frac{1}{5}$ inch).

The shrinkage in the size of the wound after grafting with small

grafts is in some cases quite remarkable. Contracture may occur under a grafted area, but it is not nearly so likely as when grafting is not done. If the grafts are placed close together contraction may be to a large extent prevented. Healing is much expedited by the use of these grafts and the resulting cicatrix is solid and resistant (Fig. 73).

Small deep grafts are apparently not replaced by scar tissue, as they can be demonstrated as definite areas of normal-appearing skin (sometimes hair-bearing), surrounded by scar tissue even after several years have elapsed.

A wound grafted with these small grafts, placed at intervals, has a dotted appearance, and the cosmetic result is not so satisfactory as when large Ollier-Thiersch, or when whole-thickness grafts are used. For this reason it is better not to use them on the face unless there is some special reason. The scars left by the removal of these grafts are after a time scarcely noticeable, except in those instances in which pigmentation or keloid occur.

The sensation of an area grafted with small deep grafts, gradually comes in from the periphery, and not from the underlying tissues.

The above-described procedure is by far the simplest method of grafting. It requires little preliminary preparation after the granulations are in condition, and unless the area to be grafted is large, it can be done in the patient's room. Enough autografts can be obtained from a small area to cover a large wound without causing any appreciable injury to a patient already in a serious condition.

A number of patients have come under my care whose lives have undoubtedly been saved by the successful use of these small grafts.

The difference in the ultimate result between small superficial (Reverdin) grafts and small deep grafts placed close together (0.5 cm. = $\frac{1}{2}$ inch) is almost as marked as the difference in results between those from Ollier-Thiersch grafts and whole-thickness grafts.

OLLIER-THIERSCH GRAFTS

Ollier-Thiersch grafts are those most generally used and are of enormous size in comparison with those advocated by Reverdin.

The method used in Dr. Halsted's clinic at the Johns Hopkins Hospital for Ollier-Thiersch grafting is simple, satisfactory, and with some slight modifications is as follows:

Source of Grafts and Area from Which They are Obtained.—The grafts are almost always cut from the thigh and usually from the *right*

when practicable, as phlebitis has occasionally developed after Ollier-Thiersch grafts have been cut from the left. The anterior and inner portion is the first choice; the external aspect next, and finally, if necessary, the posterior portion. Occasionally the skin from the arm or leg is used.

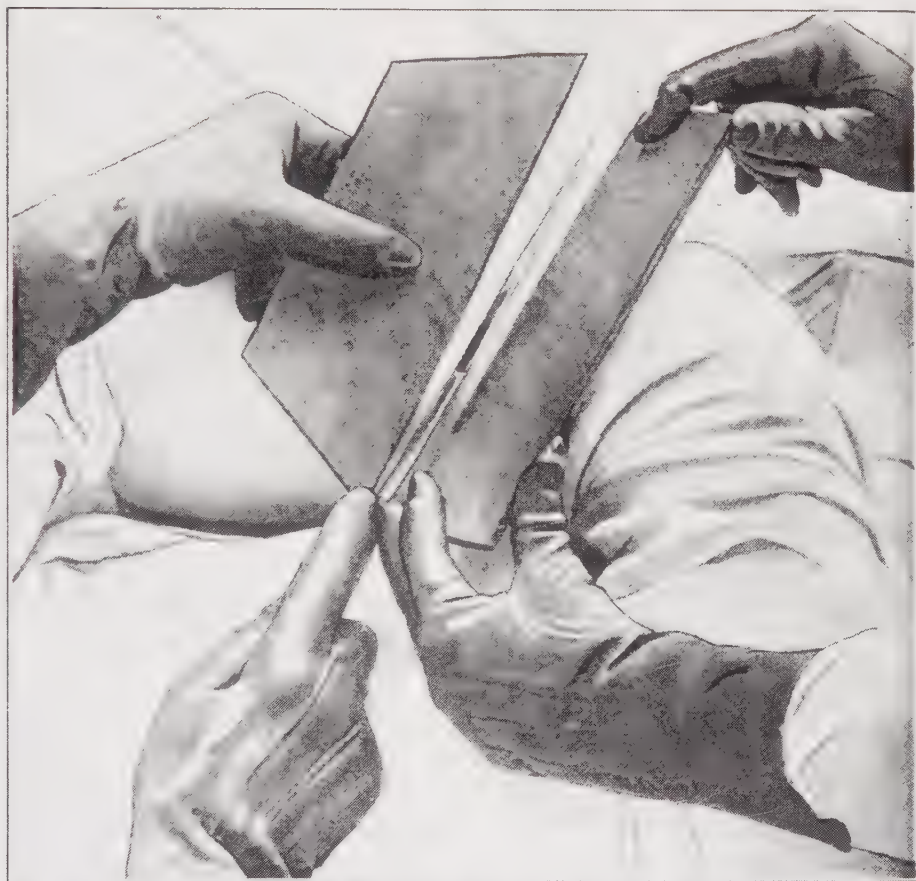


FIG. 74. The boards in place holding the skin of the thigh flat and taut. The edge of the graft is being secured to the skin. (Photograph by Schupree.)

Technic. Place a small sand bag beneath the thigh for support in order to give a better surface from which to cut.¹ Arrange the usual sterile dressing about the selected area. Care must be taken that no carbolic or bichloride solutions be brought into the field, or be allowed to touch the grafts through the medium of the dressings, gloves, or instruments.

¹ See Technic of Skin Preparation.

Firm traction is exerted on the limb. The skin, wet with salt solution, is then put on the stretch, and held as flat as possible by means of two sterile boards about 20. cm. (8 inches) long placed quite close together at right angles to the length of the limb, the first being held by the



FIG. 75.—The cutting is nearly completed. The graft is being held up by an instrument. Note the punctate bleeding from the tops of the papillae of the corium. (Photograph by Schapiro.)

assistant, and the other by the left hand of the operator. Parker suggests smearing the skin and knife with a thin film of sterile vaselin.

The edge of the thin sharp Catlin knife¹ is then engaged in the skin between these boards, and held almost flat against the limb, and by a

¹ I have found a single-edged blade broader and thinner than the Catlin more satisfactory with these boards, and use in my work either Rehns or Hoffmann's knife without the safety guard.

sawing motion the graft is cut, the knife closely following the board in the hand of the operator which is drawn slowly along in front of it (Fig. 74). The entire area being constantly kept wet with salt solution. If iodine technic is used the grafts may be cut dry. The graft should be cut at a level which will include the top of the papillary layer of the



FIG. 76.—The area from which this small graft was cut. The graft is being spread out on rubber protective, raw surface upward. By this method single grafts the full length of the thigh, and from 7.5 cm. to 12.5 cm. (3 to 5 inches) wide may be secured without difficulty. A single large graft will heal as promptly as several smaller ones, and should always be utilized when possible, as there is less scarring when one graft is used.

corium and if properly cut only a slight amount of punctate bleeding will follow (Fig. 75).

After the graft has been cut, it is placed with the raw surface uppermost upon a piece of sterile rubber protective on a board, and by means of a smooth instrument the graft is spread out evenly on the protective.

It is then covered with gauze wet in salt solution until the area to be grafted is ready (Fig. 76).

APPLICATION OF THE GRAFT.—After all hemorrhage has been checked the protective on which the graft is spread is placed over the defect so that the raw surface of the graft is next to the wound. Then the protective is lifted up on one side, the graft is gradually separated from it and is left on the defect. It is pressed down evenly on the wound with pledgets of gauze to make it adhere as closely as possible.

In every Ollier-Thiersch graft over 2. cm. ($\frac{4}{5}$ inch) in diameter, V-shaped slits should be made here and there to allow the escape of secretions and air bubbles. Occasionally several fine silk stitches are used to secure the graft in place. More especially when a deep fold is grafted, a stitch at the bottom will often aid in securing immobilization. Should more than one graft be needed, they are placed so that they slightly overlap the edges of the wound and the adjacent grafts.

By the method above described the largest and most satisfactory grafts can be cut, but this requires a skilful hand and constant practice.

Accurate placing of the grafts minimizes the scar and thus prevents to a certain extent secondary contracture. Immobilization of the part after grafting is important.

DRESSING OF THE GRAFTED SURFACE.—The dressing varies according to circumstances. I sometimes use perforated or overlapping strips of rubber protective next to the graft, and *over this gauze saturated with sterile normal salt solution*. Dry gauze is sometimes placed directly over the overlapping protective strips, or directly over the graft. Some prefer alternating wet and dry dressings, whereas others use dry powders or ointments. If protective is used and the grafts have been placed on a granulating surface, the first dressing should be done within 48 hours; if on a fresh wound, 4 or 5 days may elapse before the dressing is changed.

Sterile silver foil is an excellent dressing for Ollier-Thiersch grafts. It is put on in several layers and over this is placed the porous paper which separates the silver leaves. This dressing, theoretically, allows the secretions to come through and be absorbed by the gauze which is placed above it, but the paper, especially if it is wet with alcohol, will often form an impervious crust. The dressing is secured by a bandage and the part immobilized. The first dressing should be done ten days later.

What seems to be a failure at the first dressing will sometimes turn

out very well, and vice versa. Some grafts are moist, and there is a good deal of secretion throughout the healing process, whereas others are perfectly dry. In the moist variety a strong characteristic glue-like odor is often noticed.

Too much pressure on the dressing over the grafted area may cause sloughing of the freshly applied graft, and heavy dressings causing too much heat and sweating are to be avoided. In the majority of cases the wound caused by the cutting of the graft is healed some time before the patient is ready to leave the hospital (Fig. 77).

After using several of the flexible paraffin mixtures as primary dressings on Ollier-Thiersch grafts, I am not enthusiastic about paraffin

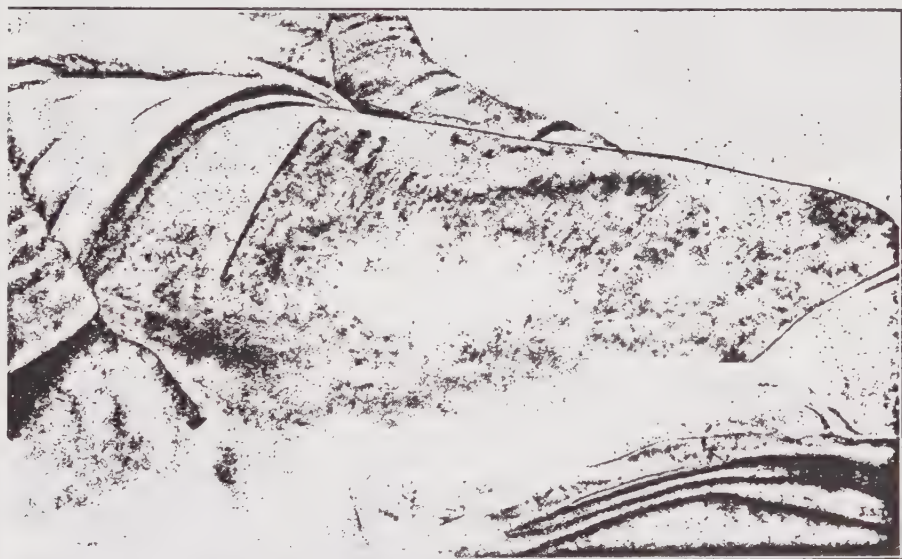


FIG. 77.—Scar on outer side of thigh due to removal of a large Ollier-Thiersch graft. Photograph taken five weeks after operation.

for this purpose. If it is employed, the dressings should be changed every day. Paraffin is much more satisfactory as a later dressing, but care should be taken not to apply it too hot.

Mayer makes a sort of cage by putting a ring of sterile gauze around the limb above and below the wound; resting on these rings little strips of sterile wood are laid, and over this is placed the wet dressing, thus making a moist chamber and preventing pressure on the newly grafted area. This is an excellent method in selected cases.

Brüning advocates leaving the grafts exposed to the open air. He



FIG. 78.—Front and lateral views of small cages made of woven wire. They are bound with adhesive plaster and are padded with felt. Similar cages may be made to fit almost any region, and may be either very small or of considerable size. The completed cage may be wrapped and sterilized with the other dressings.



FIG. 79.—A wire cage large enough to protect the chest and abdomen. The edges of the cage rest on a Bradford frame.

claims that absence of dressings prevents displacement of the grafts, that the grafts heal within eight days and there is no subsequent shrinkage. He also says that any collection of serum under the grafts can be quickly noticed and easily pressed out.

Goldman holds that inasmuch as in the open method the chief object being secure fixation, and that as this occurs within the first 24 hours, exposure to the air affords the most efficient treatment, because it dries the cementing substance. Laplace also obtains good results from the open method after grafting on healthy granulations. Bernhard grafts on healthy granulations and exposes the grafted area immediately to the sunshine. He says it dries and is stimulated to heal best by this treatment. Weischer and others claim that the results with the open method are not satisfactory.

My own experience has been quite favorable when the grafts have been exposed to the open air after a few days have elapsed, but not immediately after grafting. Exposure to the air is much facilitated by the use of molded wire cages (Figs. 78 and 79).

G. W. Davis suggests the use of wire shapes for the different parts of the body, having in the upper part a small flat tank, and going from this a flexible metal tube which provides a constant drip of salt solution to prevent the drying out of the grafts. I have not used this method but see no reason why it should not be good. Exposure to light and air are without doubt beneficial, but too early drying is harmful to freshly placed grafts.

A METHOD OF SPLINTING SKIN GRAFTS

There are many partial takes and utter failures for the reason that the grafts are not properly splinted after they have been applied, and in consequence slip down with the dressings, or are floated off by blood or serum collecting beneath them. In order to overcome this difficulty it is necessary to reinforce the grafts with some material which has enough body to act as a splint, and at the same time is not too rigid to shape itself readily to any desired situation. It is important that it should not adhere to the grafts and granulations, or cause too much pressure, and should also allow of the free escape of any secretions into the dressings.

After experimenting with various materials, I tried a coarse-meshed net, such as is used for curtains. It is made of loosely woven flat bars of cotton thread, surrounding openings about 1. cm. ($\frac{2}{5}$ inch)

n diameter. It is necessary to have the openings approximately this size, as smaller ones become clogged (Fig. 80).

In order to increase the body of the fabric, after washing out the sizing and drying, the material should be saturated with a solution of pure gutta-percha, from 15 to 30 parts (depending on the stiffness of the material required) and chloroform 150 parts. After the chloroform has evaporated and the material is dry we have a very satisfactory splinting material. When properly prepared, the mesh should be of a light greyish-brown color throughout.

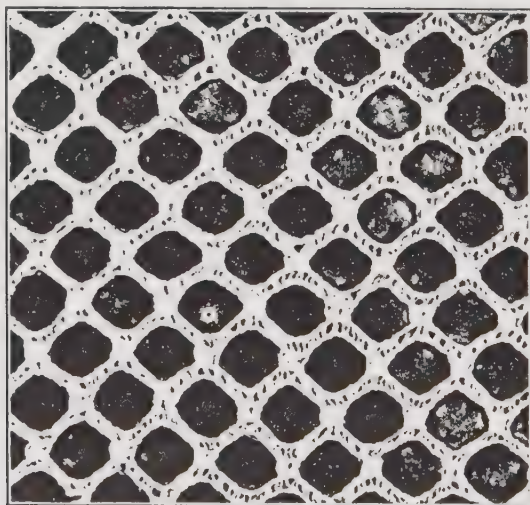


FIG. 80.—The actual size of the openings in the rubber impregnated mesh, used for splinting grafts.

STERILIZATION BEFORE APPLICATION.—Cut the fabric into pieces as large as may be desired and separate them with one or two thicknesses of gauze. Place in a sterile jar and fill with 1 to 1000 bichloride of mercury solution. Change this solution three times at twelve-hour intervals, and finally allow the mesh to remain permanently in the 1 to 1000 bichloride solution. It can be kept for a considerable time in this way (I have used it after keeping it twelve months in the bichloride solution), although it is more desirable to make small quantities as required.

Another method of preparation is to cover the rubberized mesh with 60 per cent alcohol for 24 hours, and then pour off. Then cover again with 60 per cent alcohol and after 12 hours the mesh is ready for use. The alcohol is prepared from a stock solution of bichloride of mercury 1 part, 95 per cent alcohol 2000 parts.

The dry permeated material will keep indefinitely. No hot solutions must come in contact with the mesh during the sterilization or application.

Technic.—After the grafts are in place the mesh is taken out of the solution and thoroughly rinsed with salt solution, then dried with a sterile towel. A piece is cut large enough to allow for a margin around the grafted area of from 5. to 10. cm. (2 to 4 inches). Then the material is applied and pressed snugly down on the grafted area and surrounding skin or granulations. Should the conformation of the part or wound not permit the mesh to be evenly applied, a few cuts with scissors, will

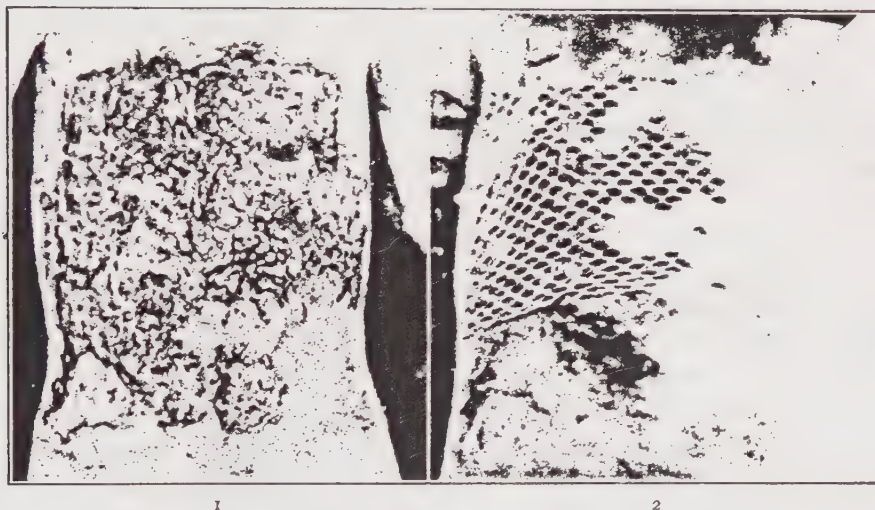


FIG. 81.—Extensive third-degree burn of the chest and abdominal wall.

1. The burn several weeks after admission.
2. The lower portion healed and the upper portion covered with rubber impregnated mesh which secures the grafts. This wound was completely healed by means of auto and iso grafts, and no contracture has followed.

permit infolding and accurate fitting, which is necessary in order that the splinting may be successful. The overlapping edges may be secured to the skin by strips of adhesive plaster when necessary. After the net is in position the dressing selected is applied, and the whole is secured with a bandage.

Where the overlapping material rests on granulation tissue, it will be found that it can be lifted up at any time without causing pain or bleeding, as the granulations do not adhere to or grow into the bars of the impregnated material.

With this mesh in place the grafts can be observed from time to time with little or no danger of displacing them. Should any blisters form,

and serum or blood collect beneath the grafts, it can be removed at once without disturbing the mesh. The first dressing is usually made in from 32 to 72 hours after operation, and the wound may be irrigated with salt solution, or secretions may be wiped away. The mesh is left in place for from 4 to 10 days, and then can be removed without difficulty (Fig. 81).

Any type of dressing may be used over this material (silver foil, wet or dry gauze, etc.) and I have found it particularly desirable in those cases in which the grafted area is exposed to the air.

I have used this open-meshed material over Ollier-Thiersch and whole-thickness grafts on nearly every part of the body, and have found its use distinctly advantageous. The openings in this mesh are too large for application over small deep grafts.

Perry described a method of impregnating silk netting with paraffin for the retention of skin grafts; he reports very satisfactory results, and believes his method to be much simpler than the one mentioned above. ♦

Tennant prepares a loose-meshed bandage by soaking it for 12 hours in rubber-tire cement, which is diluted with gasoline, and after it has dried it can be sterilized by boiling. The material is used as a bandage to hold the grafts in place. The disadvantage of the material is, that the mesh is too small.

UNTOWARD POSSIBILITIES.—The wound from which the graft is cut usually heals promptly and leaves a slight scar. In several instances, however, in the series of cases at the Johns Hopkins Hospital *phlebitis* followed the cutting of Ollier-Thiersch grafts from the left thigh, whereas no such condition was observed after they had been cut from the right thigh. Occasionally *keloid* may develop in the scar from which the graft is cut, and I have seen cases in which the entire anterior portion of the thigh was covered with a thick keloid growth following the cutting of an extensive Ollier-Thiersch graft. These grafts had been skilfully cut and were very thin, and the healing has been without infection (Fig. 82).

CONTRACTURE may occur under a successful Ollier-Thiersch graft, nor is there any way of anticipating or preventing it, the cicatricial tissue forming under and between the grafts. McBurney thought it was due to the too early abandonment of wet dressings, but no more of these cases occur when only dry dressings are employed than when wet dressings are used throughout.

RESULTS.—Sometimes Ollier-Thiersch grafts may be closely adherent to the underlying tissues, although subsequently they may become movable, and this is in marked contrast to the whole-thickness grafts, which are much more movable from the beginning. In positions where the grafted area is exposed to constant trauma Ollier-Thiersch grafts are contraindicated.



FIG. 82.—Keloid development on the thigh in a portion of a scar from which an Ollier-Thiersch graft has been cut.

A large keloid can be seen and in addition there are several smaller growths in other portions of the scar.

SPECIAL METHODS OF OBTAINING OLLIER-THIERSCH GRAFTS

Many special knives and instruments have been devised for cutting grafts, among which Mixer's rectangular fenestrated curved plate may be mentioned. On the under surface of this plate is a row of sharp needle points which serve to keep it in place. The outer edge of the plate is quite thick and gradually tapers off until the window is reached where it is very thin. The skin of the thigh is stretched and the plate is applied. Then the roller is pressed firmly down upon it, thus flattening the skin between the thin edges of the plate, and the graft is cut

with a saw-shaped knife, which follows the roller at a suitable distance. With this instrument smooth-edged, narrow grafts of uniform thickness can be cut.

Hoffmann uses a knife with a safety guard and by means of screws can regulate exactly the thickness of the graft. I have found this knife much more useful without the guard (Figs. 83-87).



FIG. 83.—Thiersch's knife for cutting thin grafts. The single edged blade is ground flat on both sides. The blade which is 8. cm. ($3\frac{1}{5}$ inches) long and 1.75 cm. ($\frac{7}{10}$ inch) wide, is placed at an angle to the handle, which is advantageous in cutting.

Doolittle has had success with an ordinary safety razor, and says that no skill is required, and good grafts of uniform thickness can be cut with this simple instrument.

Lanz cuts a long Ollier-Thiersch graft and divides it, then stamps each piece with a die which cuts a row of transverse incisions down the



FIG. 84.—Kortuem's knife for cutting Ollier-Thiersch grafts. The blade is double edged and very thin. It is 16. cm. ($6\frac{3}{5}$ inches) long and 1.75 cm. ($\frac{7}{10}$ inch) wide. This is a light and satisfactory knife.

center of the graft, and a parallel row of incisions on each side at the same time extending from the edge about a third of the way across between the central incisions. Then, by taking hold of the edges he is able to extend the graft two or three times its former length. He applies one of these opened grafts to the defect to be covered; the

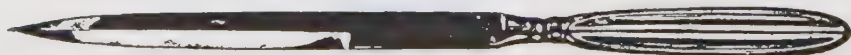


FIG. 85.—The Catlin amputating knife, which is used at the Johns Hopkins Hospital for cutting Ollier-Thiersch grafts. It is double edged, and the size most commonly used has a blade 17. cm. ($6\frac{3}{5}$ inches) long, and 1.5 cm. ($\frac{3}{5}$ inch) wide.

other pieces he places on the wound left by the cutting. Both wounds should heal rapidly and simultaneously. He holds that it is always advantageous to replace any excess skin on the wound from which it has been cut, but ordinarily such a wound heals so promptly that this feature of Lanz's technic is unnecessary. The small open spaces in the graft allow the escape of secretions and soon heal.

Parallel incisions, only partly through the skin, to form the lateral boundaries of the grafts, may be made 2.5 or 5. cm. (1 to 2 inches) apart. Fischer made the interesting observation that grafts obtained from and transplanted upon parts which have been previously rendered anemic by the use of a rubber bandage, are most successful. This sugges-



FIG. 86.—Rehn's knife for cutting Ollier-Thiersch grafts. This is a very heavy well-balanced knife. The under surface is ground flat, and the back of the blade nearest the handle is roughened to prevent the finger from slipping. The blade is 12. cm. ($4\frac{3}{4}$ inches) long, and 2.75 cm. ($1\frac{1}{10}$ inches) wide.

tion however, has not been generally adopted, as this precaution is unnecessary.

In cutting grafts it must be remembered that elastic shrinkage takes place at once, and cicatricial shrinkage later.

Thin Ollier-Thiersch grafts of uniform thickness take better than those of varying thickness. Large grafts cannot be cut from a fat or

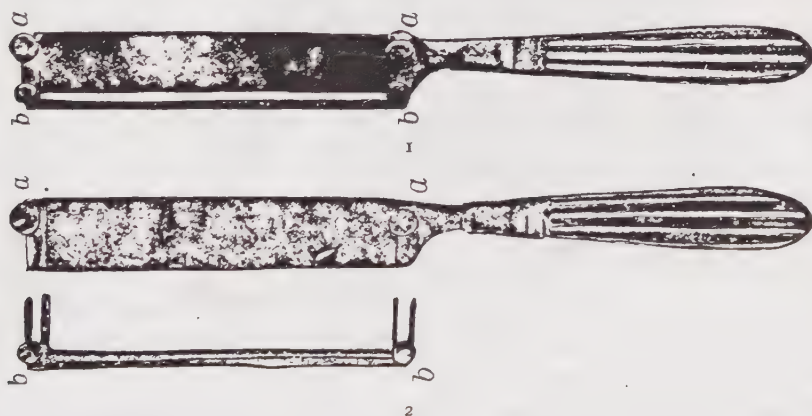


FIG. 87.—Hoffman's knife with guard, for cutting Ollier-Thiersch grafts. 1. Knife with guard in place. 2. Knife and guard separated. The guard is secured by two screws (a) which are on the knife itself. The thickness of the graft is regulated by the screws (b) which are on the guard.

flabby thigh. It is difficult to cut satisfactory Ollier-Thiersch grafts from young children on account of the thinness of the skin.

THE PERFORATION OF GRAFTS.—Vogel, after Ollier-Thiersch grafts are in place, uses curved scissors and cuts in the graft two small windows, each about 0.3 cm. ($\frac{1}{8}$ inch) square, in each square centimeter of surface. He uses a wet salt solution dressing for four or five days, then

resses with an ointment. The grafts heal smoothly into place and are never lifted up by blood or serum collecting beneath them. The little windows soon heal over, but before this takes place, they allow free escape of secretions into the moist dressings, which prevents drying.

Försterling, instead of making windows, cuts little flaps in the graft to allow drainage as long as necessary and does not leave open spaces to be covered over.

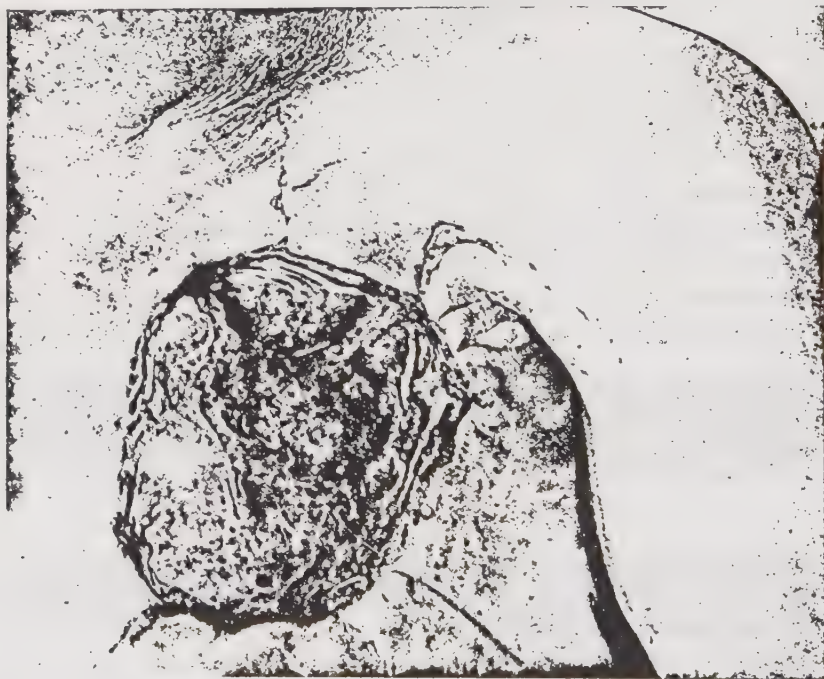


FIG. 88.—Complete "take" of Ollier-Thiersch grafts on a chest defect following a radical operation for carcinoma of the breast. Photograph taken two and one-half weeks after grafting.

These methods, especially those of Vogel and Försterling, which are very simple, have much to recommend them. In fact the recognition of the necessity of allowing the immediate escape of secretions which collect under the grafts is one of the most important advances in the technic of Ollier-Thiersch skin grafting. Experience has taught me that V-shaped openings should be made here and there in any graft wider than 2. cm. ($\frac{4}{5}$ inch).

METHODS OF MAKING THE SKIN TENSE.—McBurney introduced broad sharp retractors to hold the skin flat and tense while the graft was being cut between them; but two pieces of splint board, as previously

described, will hold the skin in a very satisfactory manner. Some operators use the hands of an assistant placed above and below for stretching the skin, and cut between them.

NECESSITY OF CONTACT.—Absolute contact is necessary and this is usually obtained by pressing the graft firmly into its bed with gauze. Wight suggests sealing the graft to its base with the high-frequency current, but this is unnecessary.

Ballance, in grafting the cavity left by a radical operation for chronic middle-ear disease, in order to obtain absolute contact uses suction through a very fine pipette, which extracts the air. This method might be used to advantage in causing the desired contact in other larger deep cavities requiring a skin graft.

Buried Grafting.—Moszkowicz, in 1916, and Esser, in 1917, described the application of Ollier-Thiersch grafts stretched on mold buried in pockets burrowed in the tissues. The technic of Esser's "epidermic inlay" method in brief is as follows (in referring to this method hereafter I will use the term "buried grafting"). He makes the pocket which he desires to line and then takes an impression of it with sterilized dental impression material. When this hardens it is removed and over it is stretched a very thin Ollier-Thiersch graft, raw surface outward. This mold covered with the graft is then inserted into the pocket, and the skin is sutured over it. Thus the graft is immobilized and is applied to the raw surface evenly and under slight pressure. After 14 to 21 days the wound is opened, the mold is removed, and the plastic operation previously planned is performed.

This method is a valuable one, and can be used in many situations and in a number of combinations. It is especially useful in lining cheek or lip defects.

Method of Securing Two Grafts from the Same Area.—Masson reports a method of securing two grafts from the same area of skin. He cuts an Ollier-Thiersch graft with a razor, and then immediately cuts another thin graft in one piece, or a number of small deep grafts from the raw surface. In order to reduce the size of the wound he excises an elongated ellipse of the tissue left after removal of the two grafts, and approximates the edges with sutures. This method of closure would be of little use except in cases in which narrow Ollier-Thiersch grafts had been cut.

I have frequently cut grafts of all types from areas from which Ollier-Thiersch grafts had previously been taken, but only after this area had healed.

OTHER METHODS OF OBTAINING THIN GRAFTS

Kellock uses a combination graft cut in one piece. He marks out the square whole-thickness portion, then with a sharp razor cuts Ollier-Thiersch grafts to the margins and turns them back; he then cuts the deep graft. This method is unnecessarily complicated and leaves a defect to be filled.

von Mangoldt's method is to scrape the skin with a razor after it has been carefully cleaned. He discards the first scraping from the surface, but when fine punctate bleeding from the tops of the papillæ is seen, the layer with most vitality has been reached. He then scrapes thoroughly and transfers the mixture of blood and epithelial cells to the fresh wound and spreads it out evenly. This method is simple and convenient, and requires much less material to cover extensive surfaces than do other technics.

Noesske, in his paper on von Mangoldt's method of grafting, claims that it has special advantages in lining cavities in long bones after operations for osteomyelitis. The cosmetic results are better than with the Ollier-Thiersch method, but the wound requires a longer time for healing. The procedure is best adapted to surfaces not exposed to friction. I have had some success in selected cases with this method.

Lusk's Method.—Lusk, in 1895, tried dried shreds of epidermis over extensive burns because no other skin was available. He secured such good results that he began to experiment.

The epidermis was obtained by vesication with a cantharides plaster, or from accidental burns and scalds. The fresh cuticle, after being cut off, was spread on gauze pads or glass slides, and sterilized as any other surgical dressing. It was then thoroughly dried and kept until needed. It should be applied dry in small pieces upon healthy granulating surfaces, not more than 1. cm. ($\frac{2}{5}$ inch) apart. He used gauze saturated in balsam of Peru one part, with castor oil eight parts; this dressing was not changed for from ten days to two weeks.

Hodgin successfully transplanted dry epithelial scrapings, which were sown on the wound. Kibbler also was successful with thin sections of thickened skin from the palms of the hands and soles of the feet. I have had very indifferent success with the methods of Lusk, Hodgin, and Kibbler.

Thiersch, in 1874, cut small pin-point grafts from the growing epithelial edge surrounding a wound, and transplanted them upon the wound successfully. M. S. Souchon again called attention to this

method in 1909. I have employed it successfully on several occasions, and also have shifted out on the wound short pedunculated flaps of this same pellicle (Fig. 89).

This method can be used on those patients who object to the removal of skin from other situations, and the procedure can be carried out with little or no pain.

WHOLE-THICKNESS SKIN GRAFTS (WOLFE-KRAUSE)

Krause says that the three things necessary for the successful transplantation of whole-thickness grafts are total asepsis, a perfectly dry technic, and suitable preparation of the area to be grafted.

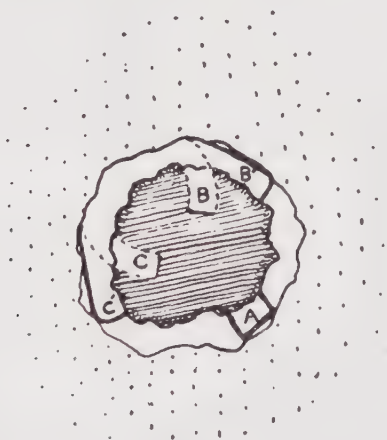


FIG. 89.—Diagrammatic drawing showing the methods of utilizing the pellicle of new skin on the margin of a granulating wound in order to hasten healing.

The dotted portion represents normal skin. The clear area between the deep black lines indicates the pellicle of new skin. The shaded area is the granulating surface.

A. The outline of a graft which may be transplanted to any portion of the granulating surface. B and C show pedunculated flaps of the pellicle shifted out on the surface of the wound. B' and C' show the outlines of incisions before the flaps are shifted.

Preparation of the Area to Receive the Grafts.—It is of the utmost importance that the raw surface on which the graft is placed be perfectly dry. It is often difficult to check the oozing and, when the bleeding cannot be stopped, it is advisable to wait for a day or two before applying the graft. If the graft is placed on an oozing wound the chances are that a blood-clot will form beneath it, which will often seriously interfere with the new blood supply. If the graft is placed on a dry surface, it has a tendency to prevent further oozing, but if any bleeding should subsequently begin it is usually localized in a compara-

very small area so that it can escape through the perforations in the raft or between the stitches.

Whole-thickness grafts may also be successfully placed on undisturbed, healthy granulations which are level with the skin edges. The grafts should be placed close to the growing edge and to each other if more than one is used. Whole-thickness grafts placed on dry granulations will adhere to them closely, and no sutures may be necessary. Grafts placed on granulations at first project above the surrounding skin, but later assume the proper level.



FIG. 90.—The outline of the incisions made for removing a whole-thickness skin graft from the leg. Note the measurements and compare them with those of the next figure.

Technic.—Mark out lightly with a scalpel on the skin an elongated ellipse, bearing in mind that the edges of the wound caused by removal of the graft should be approximated with only slight tension. Remove the skin with the underlying fat down to the fascia or aponeurosis covering the muscle. As soon as the scalpel has penetrated the subcutaneous fat the skin immediately shrinks to about two-thirds of its original size transversely and a little less in its length, so that this shrinkage must be planned for (Figs. 90–92).

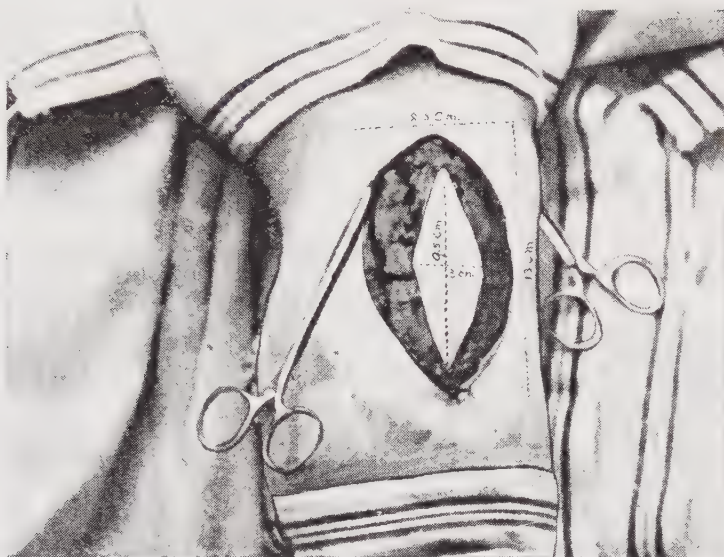


FIG. 91.—The same area, with the incision carried down to the deep fascia, without the graft being separated from its bed. A comparison of the measurements with those of the previous figure show the amount of retraction of the skin edges and contraction of the graft. This contraction varies slightly according to the location from which the graft is cut.



FIG. 92.—Method of trimming off the subcutaneous fat from a whole-thickness graft. The graft rests with the skin surface on the fingers. Beginning at one end, with curved scissors, the fat is cut as close as possible to the skin and is rolled away from the scissor as it is cut off in one piece. The greater part of the fat may be removed in this way.

Wrap the graft in dry gauze until the wound from which it has been taken is sutured and dressed. Then trim off all the fat from the graft with curved scissors. Perforate it in several places with a saddler's punch to allow the escape of any blood or secretions which may collect (Figs. 93-94). Fit the graft into the defect, either in one piece or in several pieces, depending on the shape of the wound. If one piece can be used it is advisable to secure it without tension with four cardinal



FIG. 93.

FIG. 93.—Adjustable leather punch with which openings 0.2, 0.3, 0.4 and 0.5 cm. ($\frac{1}{16}$ to $\frac{1}{8}$ inch) in diameter may be made.

This is the neatest and most satisfactory method of perforating whole-thickness grafts, and should always be used if the instrument is available.

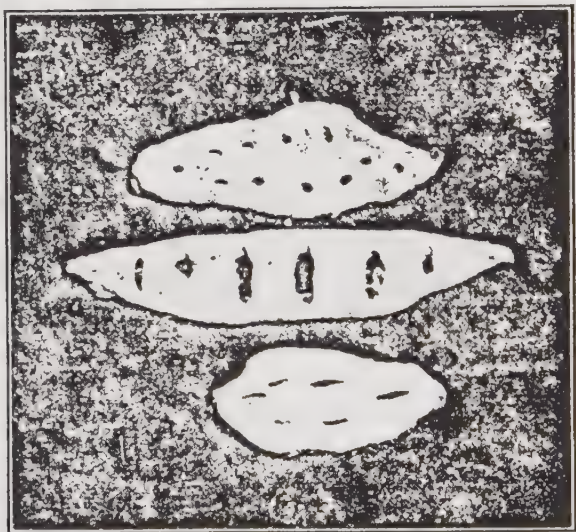


FIG. 94.

FIG. 94.—Showing methods of perforating whole-thickness grafts.

The upper graft has been perforated with a leather punch; the middle and lower grafts have been button-holed with a scalpel.

sutures, preferably of horsehair. In some instances a continuous horsehair suture is used to fill in between the cardinal sutures, and in others a few interrupted sutures. The cardinal sutures should be through the full thickness of the graft, but the sutures between should be placed superficially and should be as close as possible to the edges of the graft and surrounding skin. Occasionally no sutures at all are used, as the graft adheres closely to the dry wound, but where no sutures are used, it is advisable to secure it by means of rubberized mesh. A slight, even pressure should be exerted on the graft to hold it firmly against its base;

but too much should be avoided, as it interferes with the vitality of the graft.

The graft should be handled as little as possible, and the necessary manipulations should be most gentle. All of these points seem trivial but on them depend the success or failure of this type of graft. An Ollier-Thiersch graft may be handled with much less consideration without causing an unsuccessful transplantation.

It is essential that the wound from which the graft is taken be closed at once and not left open, as would necessarily follow if an irregularly shaped piece of skin of any considerable size was removed. It is advisable to have the size and shape of the defect in mind when cutting the graft, but it will be found that a piece of whole-thickness skin after removal of the fat is very pliable and can be easily fitted into irregular defects. It is better to have the graft too large than too small, and if the defect is irregular, after removal the graft may be cut into the desired shape, or divided and pieced together. It is, of course, desirable to fill a defect with a single piece of skin, so that there will be fewer resulting scars, but this is often impossible.

Dressings.—Silver foil; dry gauze; or moist salt gauze constantly kept wet, or allowed to dry, are all excellent dressings. Another dressing which I have found useful is a flexible paraffin mixture used by Carrel for another purpose.¹

Any of the new paraffin mixtures (Ambrine, Parisine, Redentol Stanolind Wax, etc.) will act equally well. These dressings may be used with success, but none of them should be used exclusively, as the dressing should be chosen with regard to the surroundings of the wound grafted. For instance, it is more satisfactory to dress a graft near the eye with moist salt gauze which is kept wet and often changed, as by this means the secretions from the eye are controlled, and there is less danger of infection.

Except in young children in whose cases plaster casts are indicated it is well to keep the grafted area under constant observation, without disturbing the position of the part, which should be kept immobile until the blood supply is assured (Fig. 95). The *grafted area* should be *protected from injury for at least six weeks*.

Comments.—The skin may be taken from almost any situation where there is sufficient laxity of tissue to admit the suturing of the edges of the wound from which the graft is taken.

¹ Paraffin 52°, 18. gm.; paraffin 40°, 6. gm.; beeswax 2. gm.; castor oil 2. c.c. Mix Sterilize in the autoclave and apply at body heat with a camel's-hair brush over the grafts

Grafts may be cut the whole length of the thigh, and from as wide an area as can be sutured. By using a boomerang-shaped incision a very long and wide area of skin may be secured from the abdominal and chest walls.

Not infrequently we shall find, after removing a whole-thickness graft, that large veins that have not been cut are exposed. It is better to excise these veins, otherwise they often cause pain and discomfort later.

A graft of whole thickness may be placed in the midst of scar tissue, and accomplish its purpose, because in these cases the graft is more



FIG. 95.—Plaster cast on a child's arm after grafting the hand.

Note that the elbow is flexed and that the cast extends nearly to the shoulder. In this way immobility is assured, and it is impossible for the patient to shake off the cast.

stable and flexible than the tissue which surrounds it, and the scar becomes more resistant as the tension is relieved.

In whole-thickness grafts it is important to choose the skin to be transplanted with some regard to the type of skin which will surround it. For instance, it is best where transplantation to a hairless part of the face is proposed, to select the inner forepart of the upper arm, as it is thin and practically without hair.

• As the success of the graft depends on the blood supply of its new bed, it follows that it should not be placed on denuded cartilage (with-

out perichondrium) or be used for bridging over defects. Pedunculated flaps should be used for this purpose. However, grafts can be successfully placed on healthy tendons, fascia, muscle, cortical and spongy bone, periosteum, and on the dura mater.

The Ollier-Thiersch method will, of course, remain the method of choice on account of its simplicity and smaller operative action, but in such exposed localities as the elbow, palm of the hand, knee, or heel,



FIG. 96.—Result of whole-thickness grafting for the relief of a contracture of the palm and fingers following a burn from electricity. Photograph taken eighteen months after grafting.

where there is a good deal of pressure and friction, these thin grafts will not stand the strain.

It is advisable to use large whole-thickness grafts, as the healing and adhesion is as good as with small ones, and there are fewer scars and, therefore, less likelihood of future contracture.

Extraordinary results have been obtained from the use of whole-thickness grafts in most unfavorable cases, and this type of graft should be more generally utilized.

It is of course, always wise to graft a suitable defect in the skin immediately after an operation, but should a granulating wound be presented we have to decide whether it is best to graft on the untouched granulations, or whether the granulating wound should be made a fresh one by the removal of the granulations. My own observations have convinced me that both thin and whole-thickness grafts take as well on an undisturbed granulating area as on a fresh wound, provided that the granulations are clean (free from infection).

Massage of the grafted area and surrounding skin is very advantageous, as it softens the graft, renders it more movable, and also causes it to assume more rapidly the appearance of the neighboring skin. This should not be started, however, for several weeks, i.e., until after the graft is firmly adherent to its base.

Whole-thickness grafts are used somewhat rarely and many surgeons have never used them, preferring the thin grafts.

Although the operative procedure in securing thick grafts is undoubtedly more severe than for thin grafts, and the after-care is sometimes tedious, on the other hand, the healing following a successful whole-thickness graft is as stable, firm and pliable as the original skin. I believe that the ultimate result will more than justify the time consumed, as well as the discomfort experienced by the patient (Fig. 96).

Tunnel Grafting.—MacLennan describes what he called "tunnel grafting." He removes a whole-thickness graft and then cuts this graft into pointed strips about 0.75 cm. ($\frac{3}{10}$ inch) wide and from 2.5 to 5. cm. (1 to 2 inches) long. After tunneling with forceps below the fibrous layer underlying the ulcer, he draws the graft into the tunnel. Each graft is marked with a loop of horsehair passing through the tunnel. After four or five days the graft is exposed by cutting down to it.

I can see nothing to be gained by such a method, as the operative procedure is almost as severe as it would be for the complete excision of the ulcer and its base, followed by grafting by one of the usual methods. At one time Reverdin grafts were buried in the granulations, but this method was soon abandoned as unnecessary (Pollock).

Transplantation of Hair-bearing Skin.—In a case of contracture in which the eyebrow has been destroyed, carefully shaped whole-thickness grafts of hairy skin from the pubes, with a thin layer of subcutaneous tissue, may be successfully transplanted and will relieve the contracture, and at the same time form an eyebrow. In transplantation of skin from the pubes the direction of the hair growth should be

kept in mind. Hair also grows on grafts taken from the thigh, scalp, or from any other hairy region. For this reason it is important to choose carefully the region from which the graft is taken with regard to the area into which it is to be placed.

Early Changes.—In Ollier-Thiersch grafts the upper layers macerate, leaving the deeper ones intact. In whole-thickness grafts there may be practically no maceration of the superficial layers; in some instances only the corium may remain viable. Now and then an isolated section of a graft will lose its vitality through all its layers, and a patch of granulation tissue will appear. This area should be treated as any other granulating wound.

When the superficial layers are macerated and come away, either as a whole or in part, and the epithelization of the remaining corium is sluggish, it is desirable to scatter over these areas epithelial scrapings, or small superficial grafts including as far as possible only epithelium. These grafts take readily and hasten the epithelization. The final result is excellent.

Subsequent Changes.—The result desired in whole-thickness grafting is elasticity, softness, movability and normal color. Krause says that all of these are obtained in only one-third of complete takes, although the same technic may be employed in all. My experience leads me to believe that this percentage is too small.

In some instances a brown, irregular pigmentation may appear, but this is no more frequent than in areas grafted with thin grafts, and need not be particularly considered in cases of contracture where function is more important than appearance. The graft may be cyanotic for some time, owing to enlarged blood-vessels; later the surface of a graft may become irregularly shriveled. These changes in no way impair the efficacy of the graft, but must be borne in mind from the cosmetic standpoint, and the possibilities of these complications should be explained to the patient.

HISTOLOGICAL CHANGES

The histological changes in the healing process of any type of skin graft, are, in general, similar to those which take place in the healing of an ordinary clean wound. There is an exudation of fibrin from the surface upon which the graft is placed, which fixes the graft firmly in position. This fibrin layer is infiltrated with leucocytes and fibroblasts. Vascular sprouts soon begin to form and penetrate the deeper

layers of the graft, so that in a comparatively short time the graft is supplied with blood. These new vessels have been demonstrated by the injection method in epidermic grafts on the second day, and in whole-thickness grafts on the third day. As early as the sixth day a whole-thickness graft on a fresh wound will bleed when cut (Krause). I have obtained bleeding in 84 hours from a whole-thickness graft placed on healthy undisturbed granulations. The graft itself begins to take an active part in the healing process after the third or fourth day, there being marked proliferation of cells into the underlying exudate, and an outgrowth of new epithelial cells from the edges; from the ducts of the sweat glands, and from hair follicles. Enderlen says the fibrous and elastic tissues of the graft degenerate and are replaced by newly formed tissue which probably develops, at least in part, from the pre-existing elements in the graft itself, as well as from the old fibers in the neighboring deeper tissues. In about two weeks the underlying granulation tissue is replaced by connective tissue, and this is finally the true cicatrix. The papillary structure of the newly formed skin following Ollier-Thiersch grafting, is said to be well marked in from three to four months, although I have seen the beginning of the papillary structure two weeks after grafting. A thin layer of adipose tissue develops under whole-thickness grafts denuded of fat in two to three weeks. This is most important, as it prevents to a large extent future contracture and insures movability. The scar tissue beneath the graft continues to grow for several months. The newly grafted area must not be exposed too soon to irritation or trauma. It is difficult to guard against this until the nerve supply is reëstablished, as for the first few weeks the graft is without sensation. Within four or five weeks sensation begins to be restored to the transplanted skin, which regains tactile sensibility first, then pain, and last temperature sense. The nerve fibers undoubtedly grow in from the periphery, and not from the substratum, this being shown by the fact that the border sections always regain sensation first. If the graft is large the central portion may, in some cases, remain less sensitive for a long time, but usually the sensation is entirely restored in the course of a few months.

A depressed area successfully grafted with any type of graft, will eventually fill out and assume the level of the normal skin.

CHANGES IN PIGMENTATION

In all types of grafts pigmentation may occur. In small deep grafts a brownish, blotchy pigmentation may develop both in the grafts and

in the scar between them. Ollier-Thiersch and whole-thickness grafts may also assume a blotchy-brownish color which is permanent. There is no way of preventing this pigmentation and the patient should be warned of such possibility.

The changes occurring in the pigmentation of transplanted skin are interesting. It is to be noted that in negro skin the pigment lies almost entirely in the deeper cells of the stratum Malpighii, and is practically lacking in the superficial cells. Reverdin established the fact that a pigmented thin graft from a negro transplanted upon the white skin gradually fades, and this has been confirmed by many observers, and also by our experience at the Johns Hopkins Hospital.

Pollock, however, mentions a case in which a superficial graft remained colored. Maxwell reports a case in which he transplanted a small superficial graft from his own skin in addition to some black grafts upon a defect on a negro's face, and states that the white graft remained white. Two cases are reported by J. H. W. Mayer in which negro skin was grafted on white patients, and in both instances the grafts remained black. He does not mention the kind of graft used. T. Bryant also reports a case in which several small black grafts after transplantation to a white man spread and joined each other, and finally made one black patch which remained black.

Karg says that a white graft placed on a negro, after six weeks became dusky, and from the edges black stripes extended into the white skin and black points or spots appeared in other places. The pigment gradually increased and in ten weeks the color was as black as that of the surrounding skin, although the contour of the transplanted piece was still distinct. In another case of a black Ollier-Thiersch graft on white skin, he found after two weeks that the edges of the graft were lighter, the central portion then faded, and in about five weeks also became a pale grey. The microscopic examination of the white skin grafted on the negro showed that after four weeks the epidermis in the center was entirely free of pigment. Numerous ramified pigment cells were found in the periphery, on the boundary line between the cutis and epidermis, which had sent fine offshoots between the cells of the epidermis. Granular pigment was found here and there in the epidermic cells, especially near the ramified pigment cells. Pigment granules were also found in the upper layers of the cutis, particularly in the neighborhood of the vessels. All of these were much increased after eight weeks, and after twelve weeks the pigmentation was so intense that the offshoots of the pigment cells could not be made out.

From these observations Karg concludes that the pigment is brought to the colorless epidermic cells by cells of a connective tissue nature derived from the cutis, and that they represent special chromatophores.

The black skin grafted on the white was within six weeks entirely free of pigment, except single pigment granules in the corneal layer, and larger flakes in the cutis. Single cells containing pigment were also found deeper down. The pigment, therefore, seems to be taken up and removed by migratory cells. The ramified cells with offshoots can be seen between the epidermic cells, but contain no pigment. It is interesting to note that when a whole-thickness black graft is placed on a black patient, the layers containing the pigment are cast off, and the graft becomes entirely white but the pigment slowly returns in the course of time.

Leo Loeb experimented by transplanting the pigmented skin of a guinea-pig to a place where the skin was unpigmented, or conversely. He says that following the transplantation the black skin not only keeps its own pigment, but after a variable period the boundaries of the transplanted skin, which before were very distinct, become indistinct, a darker line appearing at the margins, and gradually the pigmented area spreads in the white skin. A similar thing happens under certain conditions where white skin is transplanted to black, the black pigment spreading in the white skin. Loeb thinks that the living white epithelium is replaced by the transplanted black epithelium through a process of infiltration, and that under these circumstances there are no signs of phagocytosis, by which the black cells destroy the white ones, and further that the chromatophores originate from the epithelium itself and at no time are migratory from deeper tissues.

Karg and Loeb both worked along similar lines, but Karg used Ollier-Thiersch grafts on human beings, whereas Loeb experimented with whole-thickness grafts on guinea-pigs. The findings of Karg are generally accepted, and seem the most reasonable.

I was able to transplant several white whole-thickness grafts upon negroes, and found that after a considerable time they became dusky, the duskiness starting especially on the portion of the graft nearest the normal skin. On those grafts which were placed at some distance from the skin edges, pigmentation occurred a good deal later, as it was apparently necessary for the intervening space to become pigmented before the graft took on its pigment. In the cases in which negro whole-thickness grafts have been placed on white skin, the pigment layer is soon cast off, and as yet I have seen no return of the pigment.

In considering the loss of pigment in a black graft transplanted to a white person, and the acquisition of pigment by a white graft placed on a colored person, we must bear in mind the fact that sometimes both auto and iso white grafts become pigmented, and, moreover, that both auto and iso black grafts at first lose their pigment, although the pigment subsequently returns (Fig. 97).



FIG. 97.—Returning pigmentation in an unpigmented scar on the leg of a negro. The pigment can be seen spreading from the edges and also appearing in isolated patches entirely separated from the edges. The return of pigmentation in grafts is somewhat similar to this.

Should a white graft placed on a colored person, or a black graft placed on a white person, be unsuccessful, the resulting scars always eventually assume the color of the host.

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CHAPTER V

THE TRANSPLANTATION OF OTHER TISSUES

The remarks on transplantation of tissues other than the skin will be confined to their relationship to plastic surgery; no exhaustive consideration of the subject will be attempted.

I wish to especially emphasize again the importance of asepsis and of absolute hemostasis in the transplantation of all tissues.

The Transplantation of Fascia

Fascia is used in plastic surgery for a number of purposes. It is valuable for reinforcing weakened or defective tissues. New tendons may be constructed of it. It may be used for the relief of ptosis (of the eyelid), and for raising the drooping angle of the mouth following facial paralysis. It may also be used either alone or with fatty tissue in the mobilization of joints. It may be used free or as a pedunculated flap. If free fascia is placed in tissue devoid of scar tissue, it will survive indefinitely and retain its own characteristics (D. Lewis). If scar tissue is present, the fascia becomes infiltrated with it, and although it usually is efficient for carrying out the purpose for which it was transplanted, its microscopic picture will have changed. Free fascia flaps, with or without fatty tissue, have been used successfully in filling bone defects in the skull.

Tubes of fascia are useful between severed nerve stumps; they are valuable in guiding the formation of the protoplasmic bands and subsequently the axis cylinders.

Transplantation of Bone

Bone and cartilage are normally the supporting framework for the soft parts, and both are used for this purpose in reconstructive surgery. When bone is chosen for the supporting substance, it is advisable to leave the periosteum and, if possible, the endosteum intact. It must be borne in mind that free grafts of bone, either with or without periosteum, when transplanted into soft parts will eventually be

absorbed. I have found, experimentally and clinically, that a bone graft in contact with bone at one end, and extending into the soft parts without special function, will become thin and eventually lose its power to act as a proper support. On the other hand, if the bone transplant is placed in contact with living bone at each end, it will become a permanent supporting framework. Whether the graft lives or is replaced, is still a matter of dispute, the argument, for which will not be considered here.

Bone grafts are usually obtained from the crest of the tibia or from the ribs; occasionally from the scapula, or sternum. If the tibia is used, the bone with its periosteum is removed with an electrically driven saw, or a very thin bladed steel chisel. If the rib is used, the periosteum on the exposed surface may be removed with the rib, while the rest of the bone is shelled out subperiosteally. The bone from the rib is porous; it is much more readily shaped than bone from the tibia, and is easy to secure. Bone grafts in a bone defect need not be as large in diameter as the defect, as the tendency is for the new bone to increase in size and strength to meet the strain demanded of it. Autobone grafts are preferable, but many successful cases of isobone transplantation are reported.

Infection does not always destroy a bone graft, and enough may be left to accomplish the purpose for which it has been transplanted. Sections of bone which have not been separated from soft parts are sometimes used in pedunculated flaps. This subject will be dealt with in another section.

Transplantation of Cartilage

Cartilage is an ideal supporting substance for transplantation, when too much strain will not be placed upon it, and will live and not shrink when transplanted free (either with or without its perichondrium) into soft parts. It will also live when in contact with bone at one or both ends, although the union between bone and cartilage will not be rigid.

Cartilage is flexible and thus less liable to subsequent fracture; it can be easily cut and shaped into any desired form; it is not more difficult to obtain than bone, and a large supply is always available. Any one of these advantages, it seems to me, would suggest the use of cartilage rather than of bone for the supporting material in transplantation for the correction of saddle nose, the filling out of sunken areas on the face, and also for the framework in rhinoplastic operations. It is the best material to use in compound flaps in rhinoplastic work.

Rib cartilage is the usual source of supply. The cartilage may be obtained from the costal margin on either side. All things being equal, I prefer the left side and usually the eighth rib, which can be

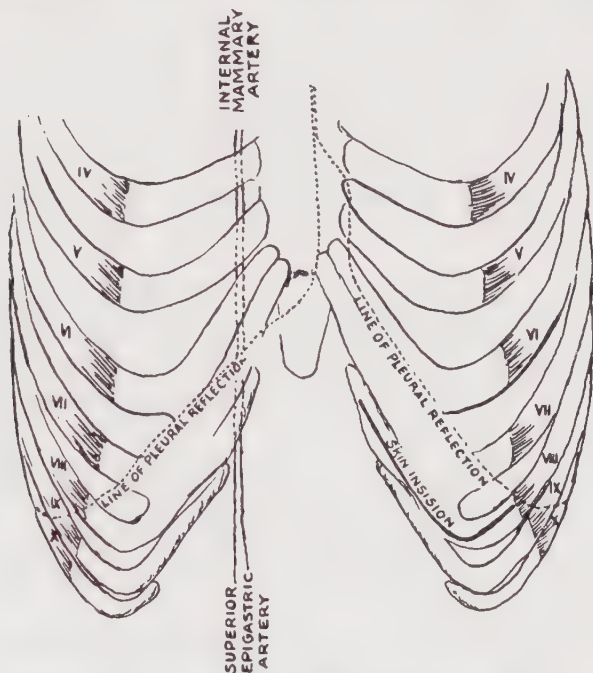


FIG. 98.—Schematic drawing of the cartilaginous ribs showing the skin incisions for obtaining cartilage grafts; line of pleural reflection; the position of the internal mammary artery. (Superior epigastric artery below the ribs.)

removed with safety. After removal it can be shaped, either free hand or according to a pattern. When broader pieces are necessary

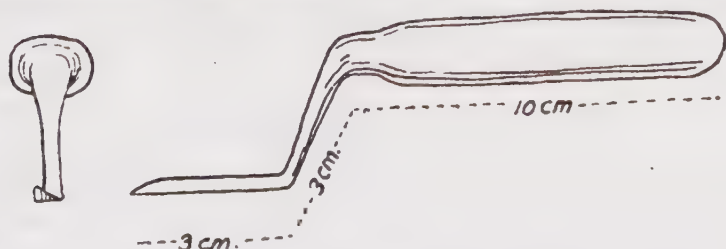


FIG. 99.—Slicing knife devised by Villandre to remove the anterior portion of cartilaginous ribs. (Woodroffe.)

With this instrument portions of the cartilage may be removed without cutting through the full thickness of the rib. By its use the danger of injuring the internal mammary artery can be avoided.

the fused portions of the cartilage of the sixth and seventh ribs may be used. Care must be taken to avoid opening the pleura. On removing

the desired portion of the fused cartilage closer to the sternum than the eighth rib, one must try to avoid cutting the internal mammary artery (Figs. 98 and 99).

Certain cases require cartilage transplants at different times in the course of extensive reconstructive work. The entire amount may be removed from the cartilaginous ribs at the time of the first operation in which cartilage is used. Those portions which are to be employed subsequently may be implanted subcutaneously in any convenient situation, and be used when needed. This procedure saves a great deal of time, often avoids the necessity of a general anesthetic, and eliminates a great deal of pain.

Cartilage has been used to fill in defects left after enucleation of the eye, to construct new supraorbital ridges, and other parts of the orbit, to repair skull defects, to replace missing phalangeal bones, and for many other purposes. It is by far the most useful and dependable of the supporting substances.

In large defects the cartilage may be used in one, or in several pieces. It has been used to fill out loss of substance even in the mandible with success. The cartilage grafts must be of the same size as the defect it is to fill, because, unlike bone, it remains unchanged, and neither increases in size nor shrinks.

Isocartilage has been often used and Morestin reports many successful cases in his work on wounded soldiers.

On account of the adequate supply it is advisable to use auto-cartilage.

I have seen cases in which infection followed the insertion of a cartilage graft, and the cartilage was visible through a sinus. In spite of this, following the free use of tincture of iodine, the graft retained its vitality and eventually accomplished the purpose for which it had been transplanted.

Transplantation of Fat

Free fat grafts are used in plastic surgery principally for filling depressions; for restoring mobility in adherent scars and preventing subsequent adhesions and contractures.

Thin or thick sheets, or masses of free fat, can be successfully transplanted. Some surgeons prefer a number of small pieces; others make one graft the size of which is limited only by the area to be filled. My experience has been that the size should depend to a large extent on the opening through which the fat is to be inserted, as sometimes it is

expedient to make a small opening to an undercut area of some size. My own preference is for the large single sheet or mass. It is always wise when using fat for obliterating depressions, to bear in mind that shrinkage invariably follows and that more fat must be transplanted than seems to be required.

If exposure is possible, I prefer to anchor the fat in position with a few fine catgut sutures. Fat should not be packed too tightly into its new bed. Asepsis is essential for success, although I know of several cases in which the fat has resisted infection and sufficient has survived to accomplish its purpose. The bed into which the fat is placed must be perfectly dry.

Often after fat transplantation a varying amount of oily fluid collects, which is undoubtedly due to the breaking down of some of the fat cells. This fluid may give the impression of infection, but if it is evacuated through a small opening in the suture line, under strict aseptic precautions, the wound (after drainage) usually will close in a few days without further trouble, and without materially interfering with the object for which the graft has been transplanted. In all surgical procedures fat tissue should be most carefully handled and it is especially necessary to prevent bruising when free fat grafts are to be used.

In experimental work I have found that autofat grafts are much more satisfactory than isografts, although a small amount of the isograft seems to survive. Clinically also this has proved true when isofat grafts have been used.

Subcutaneous fat is the ordinary source of supply, and is usually abundant in the abdominal wall, the buttock, or the thigh. Nevertheless, within the last year I have operated on two patients requiring pedunculated skin and fat flaps (who were apparently well nourished), but when the flap was raised from the abdominal wall no subcutaneous fat was found.

Omental fat has been used successfully, but one would hardly feel justified in opening the abdomen for the sole purpose of obtaining material for a fat graft.

Masses of fat may be shifted or rolled (in favorable locations), on pedicles to fill in adjacent defects and in this way better blood supply is assured. Large masses of fat attached to a pedunculated skin flap may be shifted where necessary. This method is most useful both for filling a defect and in covering the area with good skin at the same time. It is often employed when tendons are tied down by dense scar to the bones, and then after the circulation of the flap is assured the tendons

are loosened and either passed through tunnels in the fat, or are placed in grooves, the edges of which are sutured so as to surround them. Newly made tendons may also be passed through tunnels in the fat, thus avoiding adhesions.

Free fat grafts have been used by Morestin and others in filling the orbit after enucleation of the eye; in defects left by destruction of the malar bones; in skull defects to prevent adhesions; for filling bone defects, and in many other instances in which deformities were present.

Fat is often placed around nerves when adhesions are feared. It may be said that fat is a useful material in many plastic cases. It heals without irritation, and is apparently permanent. The relative size of the fat graft depends more or less on the adiposity of the individual. Strandburg reports an interesting case of a girl, 12 years old, in which a pedunculated flap of skin and fat from the abdominal wall was transplanted, for the relief of a defect on the back of the hand. But 18 years later when the patient had become very obese, it was found that the flap on the hand had also increased in size in proportion to the great increase of the abdominal wall, and his plate shows that the increase was much more marked than the increase noted in the tissues of the hand and arm adjacent to the flap. I have had patients who have become quite obese several years after the transplantation of such a flap, but have noticed no such excessive growth.

Wederhake reports a method of utilizing human fat which after suitable preparation and sterilization is in a liquid state and can be injected hypodermically. He has employed it to raise depressed and adherent scars; to pad the skin over bony prominences; for detaching nerve adhesions; for dissolving cicatricial tissue.

I have as yet had no opportunity to use liquified fat, but if further experience justifies the author's optimistic report the many advantages of the method are obvious.

Transplantation of Mucous Membrane

The free transplantation of mucous membrane is far from satisfactory, and equally good results may be obtained by the use of thin Ollier-Thiersch grafts. If mucous membrane is necessary and is available, it is best to use pedunculated flaps, as the chances of success are much greater. As a rule skin should be replaced by skin, and mucous membrane by mucous membrane, but it is often impossible to obtain a sufficient quantity of mucous membrane, and in these cases the use

of pedunculated flaps of hairless skin turned into the mouth or bladder is satisfactory. In time these skin flaps assume the characteristics with more or less the appearance of mucous membrane, and adjust themselves kindly to their new environment.

When a flap of mucous membrane is used to replace the skin, it never assumes the character or appearance of the skin. This may be especially noticed in operations around the mouth.

Transplantation of Muscle

In plastic surgery free muscle transplants are not practicable, because degeneration and necrosis of muscle substance and progressive substitution of the transplant by scar tissue follow. As a consequence the use of muscle is entirely confined to pedunculated flaps for filling defects, such as bone cavities. Only muscle flaps that have their own vessels and nerves are successful.

The temporal muscle is frequently used for this purpose, and has been shifted backward to fill in the mastoid excavation after radical mastoid operations. Morestin, as well as H. D. Gillies, has used a flap of temporal muscle to fill a depression left by the destruction of the malar bone in war wounds.

Transplantation of Tendons

In plastic surgery the transplantation of tendons is confined either to tendon lengthening in contractures of the hand or the hamstring muscles, and to occasional free tendon transplantation. Free tendon grafts from the peroneal tendon, or from split tendons, may be successfully transplanted to fill in tendon defects. New tendons may be made by tubes of fascia, or by utilizing the band of scar tissue connecting tendon stumps. If possible the new tendon should be inserted through a tunnel in the soft parts. If this is not at once possible, the scar should be excised, and the area covered with a pedunculated flap, or a graft of whole-thickness skin, and tunneling be subsequently done. Early passive motion is important in order to avoid adhesions.

Transplantation of Nerves

Nerve grafting is hardly worth trying, the ultimate result is always unsatisfactory. End-to-end suture is the method of choice, and this

may be done successfully even where considerable stretching is required before the ends can be approximated. It is, of course, necessary to remove all scar tissue before suturing. The nerve ends must be handled with the greatest gentleness, and they should be sutured accurately and without rotation.

Persistence of Vitality of Transplantable Tissues

Martin, in his series of experiments, found that none of his skin grafts lived and were effective after 108 hours in "free air" at a temperature of nearly 0°C. (32°F.), but were successful after as much as 96 hours in free air. When kept in hermetically sealed tubes, or confined air, under the same temperature conditions, the grafts could be successfully transplanted after 108 hours. Where the temperature was 5°C. (42.8°F.) the limits were 82 hours in free air, and 96 hours in confined air. At 12°C. (53.6°F.) the limits were 72 hours in free air, and 84 hours in confined air.

At 15°C. (59°F.) the limits were 60 hours in free air, and 72 hours in confined air.

At 20°C. (68°F.) the limits were 36 hours in free air, and 36 hours in confined air.

At 28°C. (82.4°F.) the limits were 6 hours in free air, and 7 hours in confined air, respectively.

He came to the conclusion that cold favored the success of the transplant and heat was unfavorable and caused a shorter duration of vitality. He also concluded that moisture hastened decomposition, smaller masses lived longer and grafts were best preserved in hermetically sealed tubes at low temperature. It must be remembered that these experiments were made before the days of asepsis.

Brewer was able to use successfully Reverdin grafts obtained from skin removed from a cadaver as long as 36 hours, but not longer.

The skin of amputated limbs has also been successfully transplanted from 36 to 96 hours after amputation. I have successfully transplanted on to healthy undisturbed granulations pieces of whole-thickness skin (taken from a leg 18 hours after amputation), at various intervals up to 30 days. The superficial portions of the grafts kept over 48 hours sloughed and only the bases adhered. Some of the grafts were several centimeters in diameter. This skin was kept in an ordinary ice chest in a sterile jar plugged with cotton, containing a gauze sponge wet with normal salt solution. I have observed that whole-thickness grafts

which are to be preserved for any length of time will take better if the subcutaneous fat is allowed to remain intact and not removed until the time the graft is needed, and then the fat is removed.

Girdner successfully grafted skin from a cadaver 6 hours after death. Many others have also obtained grafts in this way.

Wentscher grafted successfully pieces of skin kept for from 7 to 14 days in sterile tubes with moist salt gauze and cotton plug, and was able to demonstrate mitosis. He concluded that grafts can be used with safety from 24 to 48 hours after cutting, but usually not longer than 48 hours.

Ljungren grafted with success pieces of skin kept in sterile ascitic fluid for from 2 days to 3 months; the microscope showed that the epithelium had multiplied by karyokinesis.

Burkhart found that grafts lost nothing in vitality if applied within 24 hours after being cut, either on fresh wounds, or on undisturbed granulations. In cases in which there was much bleeding, he applied the grafts 24 hours later, after all hemorrhage had ceased. This has also been my experience, especially with whole-thickness grafts. Burkhart obtained partial success with grafts preserved 8 days in a moist chamber, and 12 days in a dry chamber.

Dried epidermic scales have been successfully transplanted 418 days after removal from the patient.

Tuffier in 1910 and 1911, preserved in cold storage in petrolatum, bone, fat, cartilage and periosteum, which he had taken from amputated limbs. These tissues were kept for from a few hours to two months and were successfully transplanted for one purpose or another.

In 1911 Magitot preserved an eye which had been extirpated for glaucoma, for 8 days in human serum at a temperature of 4°C . (39.2°F .) He then used a piece of the cornea of this eye to fill a defect made by the excision of a scar on the cornea of a man whose eye had been burned. The graft lived, and 7 months later was transparent so that the patient could see through it.

Carrel in 1911 experimented with the tissues of an infant who had died at birth. Several hours after death the body was washed with soap and water, followed by ether. Dermo-epidermic grafts and flaps of skin were removed and washed in Ringer's solution. Bones were also secured. Some of the tissues were placed in tubes containing warmed sterile petrolatum and others in tubes of Ringer's solution. All were kept in a refrigerator at a temperature of 3°C . (37.4°F .) for from a few hours to 7 weeks. The skin was successfully used for graft

g ulcers. After five months the tissue in petrolatum was histologically normal. After a few weeks the tissue in Ringer's solution began to disintegrate.¹

My own experience has been limited to the preservation of skin, fascia, tendon, bone and cartilage. All of these tissues may be preserved by simple methods, the ordinary petrolatum used by Carrel being probably the simplest and best preserving medium, stored at a temperature of about 3°C. (37.4°F.).

This brings up the question of the feasibility of isografts. Lexer at the 1911 Meeting of the German Surgical Congress, and again before the International Society of Surgery, April 15, 1914, made the statement that isoskin grafts were never successful, and that none of them ever lasted longer than three weeks. I cannot agree with him, as I have seen a number of permanently successful isoskin grafts. On the other hand, Lexer said he had successfully transplanted whole isojoints, with good results, which hardly seems consistent.

The limitations of the preservation of tissues for future transplantation have not been fully worked out, but the possibilities are fascinating.

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¹ Ringer's Solution.—Sodium chlorid.....0.7 per cent.
 Potassium chlorid.....0.03 per cent.
 Calcium chlorid.....0.025 per cent.
 Water

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CHAPTER VI

PEDUNCULATED FLAPS

In the present war there have been many whose wounds have caused the loss of skin and subcutaneous tissue, and even deeper tissues, in situations which ultimately will require a resistant elastic healing before a satisfactory functional result can be obtained. Many of these defects can be properly remedied only by the use of pedunculated flaps of skin and subcutaneous tissue (Figs. 100 and 101).

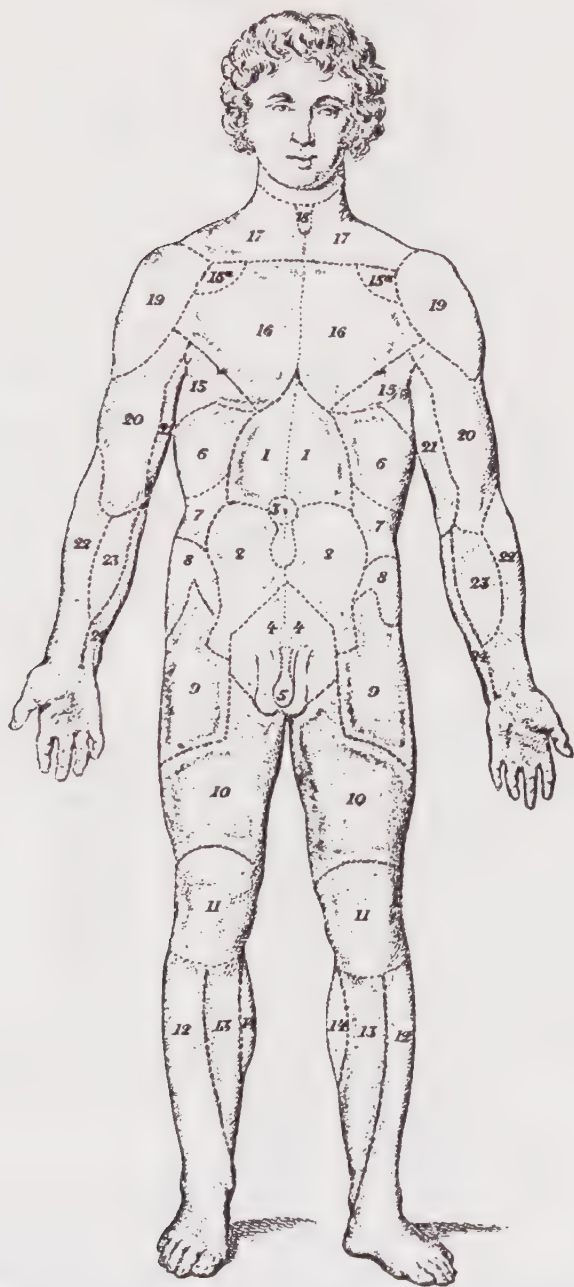
By a pedunculated flap I mean a mass of tissue, usually the skin and subcutaneous fat, which is raised from its bed but is left attached to the surrounding skin at a selected portion of its periphery. There is another type of pedunculated flap with a pedicle of subcutaneous tissue, the skin being cut all around it. It was first used by Gersuny and is useful in closing defects in the mucous membrane. Esser has recently described similar flaps, calling them "Island Flaps."

Through this skin or subcutaneous attachment, called the pedicle, the flap receives its blood supply. The flap can be shifted, as far as its pedicle will permit, to fill the defect.

Pedunculated flaps may be obtained from tissue in the neighborhood of the defect, or from a distant part. There may be a single, or a double pedicle.

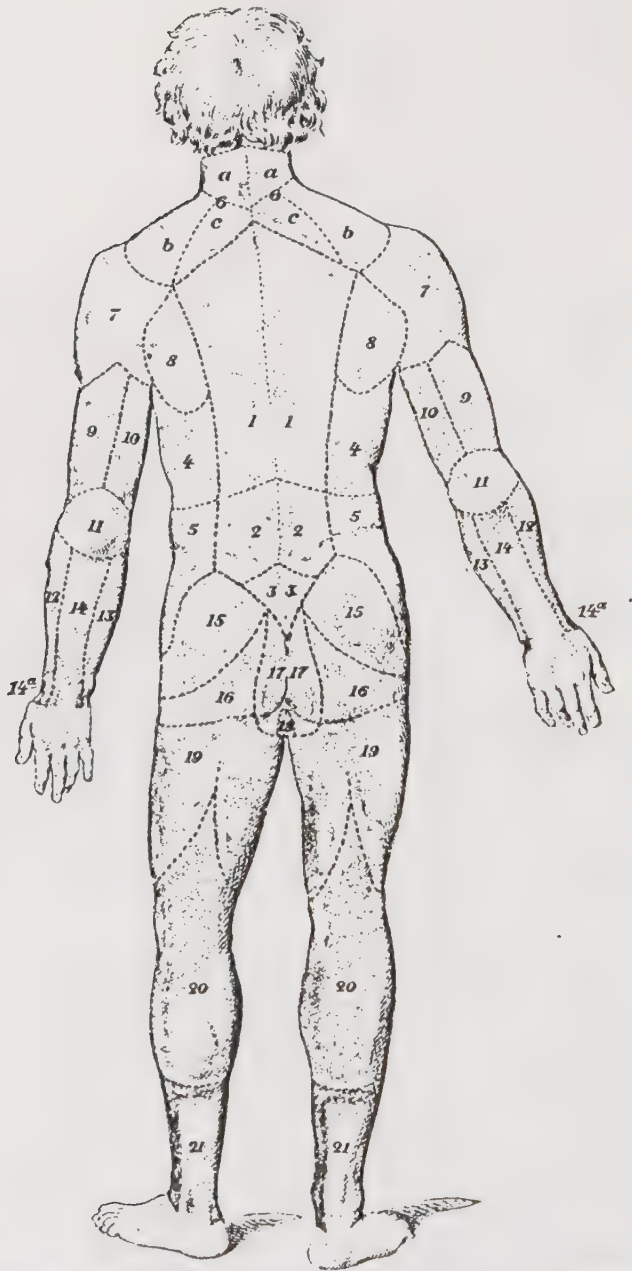
There are three general methods of obtaining pedunculated flaps. (1) *The French method* of sliding flaps from adjacent tissue in which process there is little or no torsion of the pedicle. (2) *The Indian method*, in which the flap is obtained from the immediate neighborhood of the defect and is shifted into its new position by more or less twisting of the pedicle. The pedicle of the flap may be adjacent to the defect, or it may be necessary for the pedicle to bridge over normal tissue before the flap can be placed in its new position. (3) *The Italian or Tagliacotian method*, in which the flap is obtained from a distant part, usually from the arm.

A way of further utilizing pedunculated flaps was described by Dr. W. S. Halsted in 1898. He reported a method which he had used in the treatment of an extensive burn of the cheek, neck and arms, and he spoke of the method as "waltzing" the flap. He says, "None of the



Outlines showing the skin regions supplied by different arteries. (Manchot.)

FIG. 100.—1. The superior superficial epigastric artery; 2. The inferior superficial epigastric artery; 3. The superior and inferior superficial epigastric arteries; 4. The external pudic artery; 5. The dorsal artery of the penis; 6. The perforating branches of the intercostal arteries; 7. The perforating branches of the lumbar arteries; 8. The superficial circumflex iliac artery; 9. The profunda femoris and internal circumflex arteries; 10. The femoral artery; 11. The arterial anastomosis around the patella; 12. The anterior tibial artery; 13. The posterior tibial artery; 14. The popliteal artery; 15. The superior and long thoracic arteries; 15a. The acromiothoracic artery. 16. The perforating branches of the internal mammary artery; 17. The thyroid axis; 18. The superior thyroid artery; 19. The anterior circumflex artery; 20. The brachial artery; 21. The inferior profunda artery; 22. The radial artery; 23. The median artery; 24. The ulna artery.



Outlines showing the skin regions supplied by different arteries (*continued*). (Manchol.)

FIG. 101.—1, The dorsal branches of the intercostal arteries; 2, The dorsal branches of the lumbar arteries; 3, The dorsal branches of the sacral arteries; 4, The posterior perforating branches of the intercostal arteries; 5, The posterior perforating branches of the lumbar arteries; 6, The thyroid axis; a, Superficial cervical artery; b, Suprascapular artery; c, Transversalis Colli artery; 7, The posterior circumflex artery; 8, The dorsalis scapulae artery; 9, The radial recurrent artery; 10, The inferior profunda artery; 11, Arterial anastomosis around the olecranon; 12, The radial artery; 13, The ulna artery; 14, The anterior and posterior interosseous arteries; 15, The gluteal artery; 16, The comes nervi ischiadici artery; 17, The internal pudic artery; 18, The obturator artery; 19, The perforating branches of the profunda femoris artery; 20, The popliteal artery; 21, The anterior and posterior tibial arteries.

original attachments of the last flap which we used have been preserved. The flap has twice been twisted upon itself, first upon a small pedicle of skin, original tissue we may call it, and secondly upon a little broader pedicle of cultivated cicatricial tissue. The flap has probably made a complete revolution." In my own work I have found it possible to shift masses of skin and subcutaneous fat gradually into positions far removed beyond the restriction of the original pedicle.

THE TRANSFERENCE OF THE FLAP

The transference of the flap may be *single*, that is when it is placed directly on the defect. This may be done whether the flap is from the neighborhood or from a distant part either immediately after cutting (fresh) or after granulations have formed.



FIG. 102.—Double pedicled bridge flap showing skin sutured beneath it.

If skin edges cannot be approximated the raw surface may be grafted.

The transfer may be *multiple*, or by *successive migration*, that is where it is impossible on account of its position to place the flap directly on the defect. For instance, in cases in which it is advisable to use a flap from the abdominal wall to repair a chin, the flap is raised and grown into an incision in the forearm or hand. Then, after the circulation has been established from the forearm, the pedicle is amputated from the abdomen and the flap is transferred on the forearm to the chin. In due time the flap is cut away from the forearm and is immediately fitted into its new bed. By this method transfer has also been made from abdomen to chest, to neck, to chin, and in other combinations. It should be emphasized at the onset that the raw surface of the flap necessarily granulates and the shrinkage is considerable.

If an abdominal flap be used with a pedicle on one side of the midline, it is advisable, on account of the arterial distribution, that the skin of the flap be taken from the same side. This is unnecessary where the pedicle includes skin on both sides of the midline.

The area from which the pedunculated flap is taken may be closed with sutures if the skin is lax, or after undercutting and sliding. I

closure is not possible on account of the size of the area, it may be covered with skin grafts, preferably of the Ollier-Thiersch variety (Figs. 102 and 103).

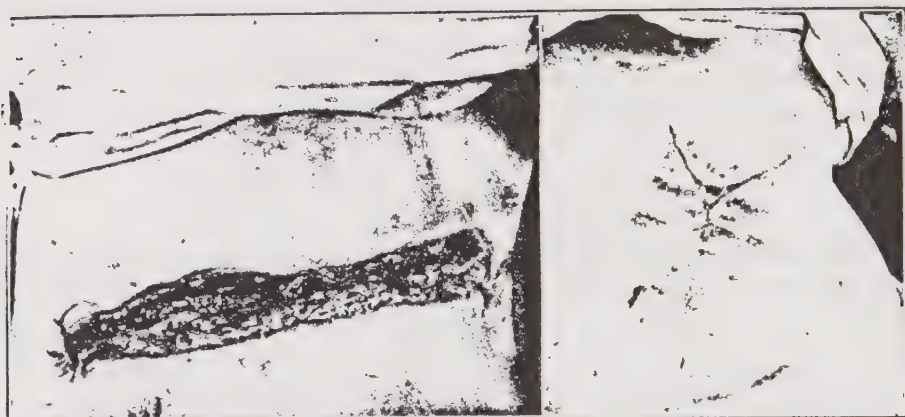


FIG. 103.—Methods of dealing with defects left by the removal of pedunculated flaps from the abdominal wall.

1. A broad pedicled flap was raised and transplanted into the forearm, and after the pedicle was severed the defect was grafted with Ollier-Thiersch grafts. The photograph was taken two weeks after grafting and shows the wound not quite healed.
2. A flap with a comparatively narrow pedicle was raised and was implanted into a hand defect. After the pedicle was cut the edges were drawn together and sutured.

Both of these methods are satisfactory.

TYPE OF FLAP

Pedunculated flaps may be *simple*, where only the skin and subcutaneous tissue is used, or *compound* where periosteum, bone, or cartilage is included in the flap.

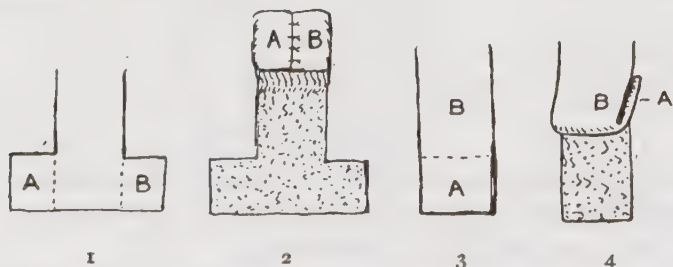


FIG. 104.—Methods of making double thickness flaps with epithelium on both sides. (Cole.)

1. Outline of incisions. The area between the dotted lines is the portion of the flap to be lined.
2. The flap raised. The wings *A* and *B* being turned in and sutured.
3. Outline of flap, which is folded on itself at the dotted line.
4. The free end of the flap *A* folded and secured. These are old and useful methods.

In *compound* flaps the periosteum or bone may be taken up with the flap without being separated from the soft parts, as when periosteum

and bone are raised from the frontal bone in certain rhinoplastic operations, or when a portion of the clavicle is raised with a flap from the neck to repair a jaw defect.

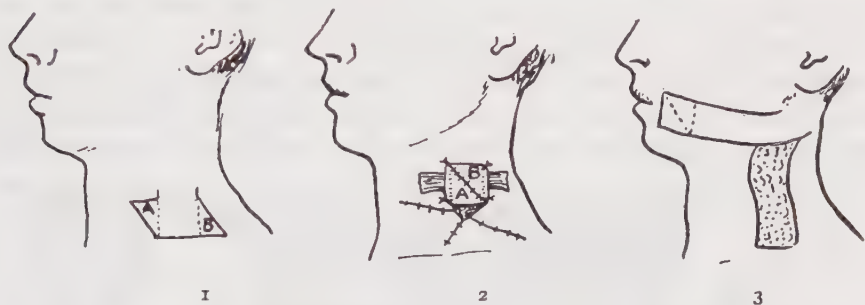


FIG. 105.—Method of making a flap with epithelium on both sides. (Cole.)

1. The dotted lines indicate the area to be lined. The triangles A and B are to be folded under and sutured.
2. Shows this accomplished and wound nearly closed. The double surfaced flap is stretched on the skin of the neck and held by sutures.
3. The pedicle extended upward and the flap in position. The neck defect may be partially sutured and the rest of the pedicle should be utilized to close the upper portion of the neck defect.

When cartilage is used, a shaped section of cartilaginous rib is ordinarily transplanted to the desired location in the future flap, and after it has become established in its new position (3 to 6 weeks) the flap containing the cartilage is raised and shifted to the defect.

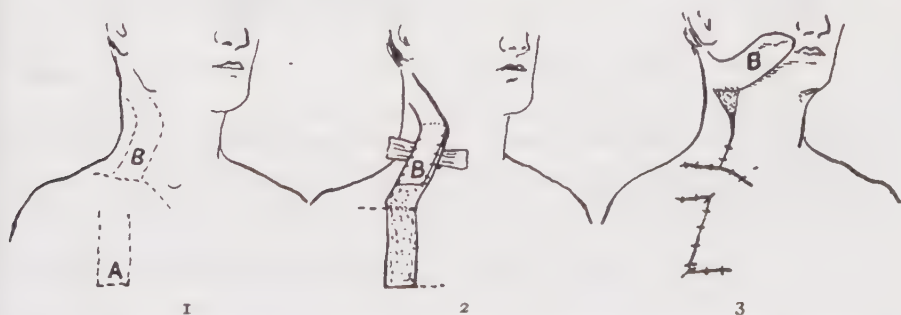


FIG. 106.—Method of making a flap with epithelium on both sides. (Cole.)

1. Outline of the flaps.
2. The flap from the chest is turned upward and is sutured under the neck flap.
3. The pedicle of the chest flap is cut and the double-faced flap with its pedicle on the neck is shifted where desired. This method is advantageous where it is not possible to obtain sufficient tissue by the use of one pedicle.

This method is also used when it is desirable to use free bone, or free periosteum in a flap.

Double-faced Flaps.—If a pedunculated flap of any considerable size is used to construct a lip or eyelid, or to fill a defect inside the

nouth, an epithelial and not a raw surface should be placed inside the cavity. Unless this precaution is taken contracture will take place, because the mucous membrane does not spread with sufficient rapidity to cover a raw surface of any size in time to prevent contracture.

For example, when the reconstruction of the lower lip is contemplated and lateral flaps of the full thickness of the cheek cannot be used, it is necessary to have a flap which is covered with epithelium on both sides. This may be accomplished by grafting the under surface

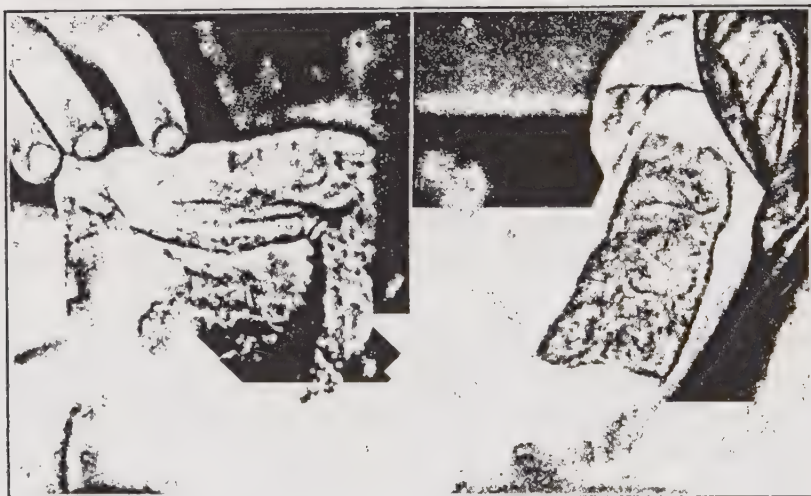


FIG. 107.—Method of folding an arm flap on itself in order to obtain epithelium on both sides.

1. The flap has been raised from the arm and folded on itself. Photograph taken two weeks later. The double-faced flap is stretched on a gauze covered wire frame to prevent unnecessary contracture.

2. The area from which the flap was raised covered with Ollier-Thiersch grafts. Photograph two months later.

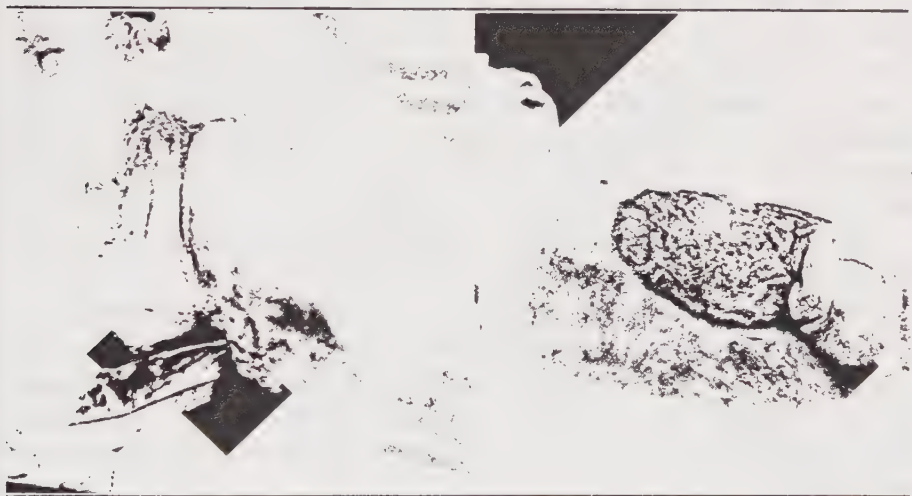
of the flap and waiting until the healing is complete before transferring the flap, as is well described by Watts. Another, and in my own experience a better method is to fold the end of the flap on itself and allow the raw surfaces to heal together, after which the transfer is made in the usual way. If a supporting substance is necessary in such a flap, free cartilage may be inserted between the raw surfaces (Figs. 104-108).

According to Lefèvre, in cheek plastics Chavannaz obtained good results in two cases by turning the raw surface of a pedunculated flap inside. Lefèvre did some experimental work on dogs to prove this

point, and found the results very satisfactory, the raw surface healing in from 16 to 30 days.

My own experience leads me to believe that only flaps covered with epithelium will prevent subsequent contractures when turned inside the mouth.

Symbiotic Transplantation.—The attachment of one person to a pedunculated flap raised from another (which may be called symbiotic transplantation) has been attempted a number of times, but without very satisfactory results. Finney reported an unsuccessful case of this kind before the American Surgical Association on June 5, 1909, and



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FIG. 108.—A pedunculated flap from the arm with its pedicle toward the elbow.

1. The flap raised. The defect on the arm was immediately grafted with Ollier Thiersch grafts. This flap was implanted into a nose defect but did not adhere. Its under surface was then grafted and the patient allowed to go home for six months.

2. The condition of the arm and flap after the patient returned. There has been contraction of the grafted surface of the flap and shrinkage has taken place. The flap was subsequently uncurled and was used with success for the purpose desired.

quoted Lund, who had had little better success in his own case. In both of these cases there were unavoidable complications which tended to cause failure. The method is even more trying on the participant than when autoplasty is practised with pedunculated flaps from distant parts, and for this reason is not to be recommended. Nevertheless there is no reason why such a procedure should not be successful under favorable conditions.

O. Laurent reported four cases in which he successfully used pedunculated flaps from other persons for the repair of extensive humerus or

femur defects. The donors and recipients were fastened together for from 8 to 10 days. Excess bone in amputation stumps, which required shortening, was used in each case, and the results were said to be satisfactory.

IMPORTANT SUGGESTIONS

In using pedunculated flaps the following are some points which experience has shown to be essential for success.

The patient should be in the best possible physical condition. Asepsis rather than antiseptics should be maintained throughout the operation and during convalescence. The tissues should be treated with the greatest consideration. Keen-cutting instruments must be used, in order to avoid unnecessary injury to the tissues. The flaps should be handled with special forceps or small sharp hooks. All hemorrhage should be checked in the area into which the flap is to be transferred. Accurate apposition of the sutured edges is desirable because prompt healing minimizes scar tissue.

The sutures should be placed so as to avoid tension, which always jeopardizes the success of the flap.

Pedunculated flaps are especially valuable when a pad of fat in addition to the whole thickness of the skin is required to fill a defect.

Flaps usually include the skin and as much of the subcutaneous fat as is needed. The fat should be somewhat thicker than is actually necessary to fill the defect, because the excess is cared for by subsequent shrinkage.

The shape of the flap must correspond fairly accurately to the defect which it is to cover. Long-pointed flaps should be avoided, on account of almost certain necrosis of the tips. Thin flaps are so pliable that they can be easily adjusted to fit a defect of almost any shape. In rhinoplastic operations it is desirable to outline the flap from a carefully calculated pattern.

The skin of pedunculated flaps must be chosen with some regard to the character of the skin surrounding the area into which it is to be put. That from the immediate neighborhood usually matches better than that from distant parts.

Unless it has been previously depilated a flap of hairy skin should never be turned into the mouth, or any other mucous lined cavity, because the hair will continue to grow and will cause much discomfort. The same rule to a less extent holds good in shifting flaps of hairy scalp to fill defects on hairless portions of the face. Recently P. P.

Cole reported that he had used a flap from the hairy scalp to repair a facial defect and that subsequently the hair was readily removed by radiation, so that a smooth skin was left.

The flap should be cut at least one-third larger than the area it is to fill, as there is always immediate shrinkage in the direction of the elastic fibers.

Normal skin is necessary for a successful flap, because any scar on the edge will usually slough and a scar running across a flap will completely cut off the circulation beyond it.



FIG. 109.—Method of shifting flaps without torsion of the pedicles. (*Jacobovici.*)

The dark lines indicate the incisions for raising the flaps. The dotted lines show the positions into which the flaps are shifted.

Whenever possible all scar tissue should be excised, especially along the edges to be sutured, as the healing will be more satisfactory if normal tissues are approximated.

The pedicle should be as broad as possible, but in all flaps which are to be twisted it should be narrower than the body of the flap. In flaps from the immediate neighborhood one should always aim to have the pedicle very close to the loss of substance and, when practicable, the long axis of the pedicle should be in the same direction as the axis of the flap in its new direction. The pedicle of a flap should be in the same line as the area to be filled (Fig. 109).

The elasticity of the skin will allow a curved flap to assume a straight position without difficulty.

As a general rule the flap should never be longer than from two and one-half to three times the width of the pedicle, unless it contains a

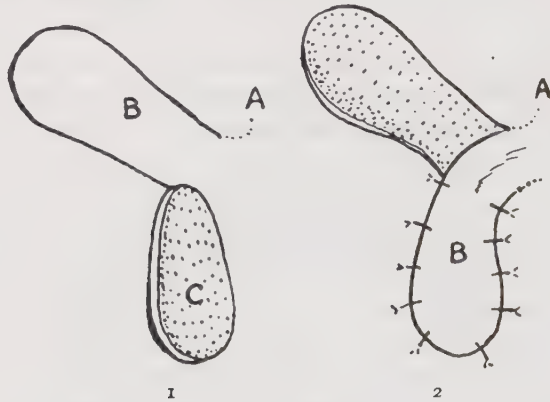


FIG. 110.—The Indian method of using a flap of adjacent tissue.

1. The dark line indicates the outline of the flap *B* to fill the defect *C*. Note that the flap *B* is larger than *C*. The dotted line *A* indicates the line of incision if more freedom is desired for the pedicle.

2. The flap *B* covering the defect. The raw surface from which the flap is raised may be sutured or grafted.

main artery, in which case the pedicle may be much less wide and the flap less thick. However, a main artery is not essential if the pedicle is adequate and the flap is thick enough to include a number of small vessels sufficient for its proper nutrition.



FIG. 111.—Methods of scarifying pedunculated flaps.

If the pedicle of a flap adjacent to the defect is too short to allow turning into the defect without tension, the incision not terminating in the defect should be prolonged outward (Fig. 110).

A pedicle should never be notched at the time of implantation in

order to make it fit better, as there is risk of impairing the circulation. If there is puckering of the edges of a pedicle, it can be adjusted after the new circulation is assured.

Twisting or too much tension on a pedicle may cause shutting of of the circulation and gangrene of the flap.

Occasionally gangrene occurs in a flap which has an excellent blood supply; this may be due to lack of drainage from the flap, or in other words the flap is choked with the blood and lymph that enter it, but are unable to get out promptly. This accident is especially to be feared if the pedicle contains a main artery. To overcome this danger C. H. Mayo suggested superficial scarification of the flap to allow surface

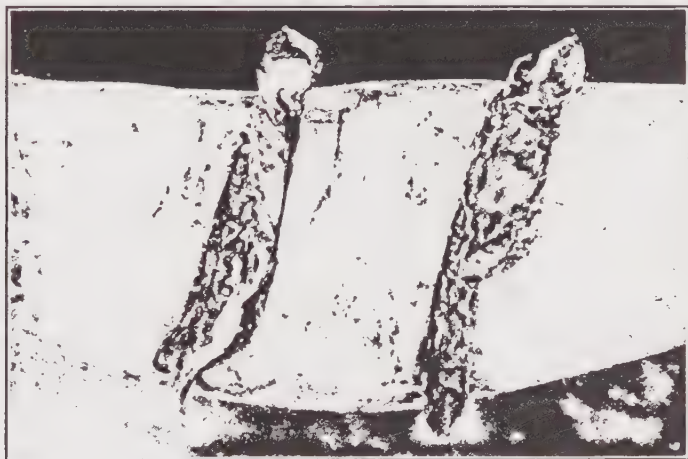


FIG. 112.—Method of preparing a flap before shifting it to its new position, by raising it from the underlying tissues and keeping them separated with paraffined liner

Neither pedicle is severed at first, but after a week the extremity which is to be the free end is separated by gradual notching on one or both sides. In this way the blood supply of a long narrow flap may be practically assured before it is transplanted.

drainage until proper vessel drainage is established (Fig. 111). This procedure I have found very satisfactory. When a long narrow flap is required and there is doubt about the blood supply, it is advisable to raise the flap from its bed but leave it attached at each end (a method emphasized by Croft, but also practised by Tagliacozzi in his original operation). After the flap has been raised it is advisable to close the skin beneath the flap, or else to keep it separated from its bed with rubber tissue; or the bed beneath the flap may be grafted with Ollier Thiersch grafts. After two or three weeks one pedicle should be cut, the granulating surface freshened and the flap transferred in the usual

manner. The other pedicle should be severed later on (Figs. 112 and 113).

Perthès, in order to attain the same end, uses the following methods, which have much to recommend them.

1. The flap is more or less completely marked out by an incision, and detached from the underlying tissues. It is then sutured back in its original position and the wound is allowed to heal by first intention. About eight days later, or (if a series of such preparatory incisions is preferred to a single one) eight days after the last incision, the flap is swung into its new permanent site. As the circulation has been completely interrupted wherever the skin was divided, or undermined, collateral circulation by way of the pedicle is stimulated, whereas any

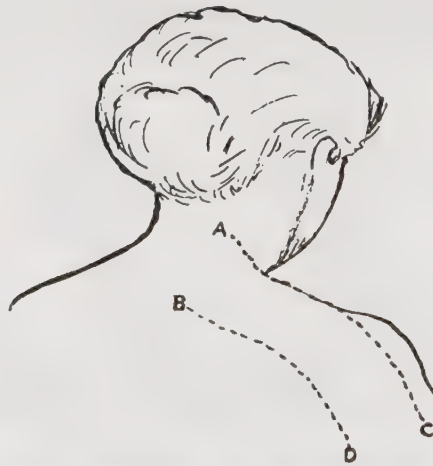


FIG. 113.—Method of using a long double pedicled flap for the relief of a neck defect. (Croft.)

The dotted lines indicate the extent of the flap raised from its bed. The under surface is prevented from adhering to the underlying tissues, but the pedicles are not cut. Later the lower pedicle DC is divided and the flap is shifted in to fill the neck defect. This is a slow but sure method.

circulation reestablished across the line of incision and undermined area is negligible. In this manner the flap is assured of an adequate blood supply through its pedicle before it is transferred. Another advantage lies in the fact that the flap does not shrink as much as if it had been transferred at once to its new position.

2. The outline of the flap is obtained by compressing the skin along the lines to be followed when it is ultimately cut and transferred. This compression is effected by running a large darning needle under the skin which covers all but the ends of the needle. A second needle is

placed over the skin parallel with the first, to the ends of which it is secured. The skin between the needles is thus nipped, and in about an hour the area of skin so marked off will show changes of color and temperature, and will no longer turn white on digital pressure. By this method, which can be carried out in stages at intervals of about eight days, the blood supply of the prospective flap can be regulated so as to pass mainly through the part destined to act as the pedicle, and adequate provision can be made for the blood supply of even a long and narrow flap. Instead of the darning needle, a modification of Makkas clamps for compressing the scalp before trephining may be used.

I have found that the surety of a blood supply before transplantation of the flap is very advantageous, and the principle deserves wide recognition than has hitherto been accorded it.

I usually wait for from ten days to two weeks before amputating the pedicle of a flap. Some have advised amputation as early as the fourth day; others insist that three weeks should elapse before severing the pedicle. The circulation of the flap may be tested before cutting the pedicle by applying a stomach clamp across the pedicle tight enough to shut off the circulation, but not sufficiently tight to damage the tissue. The amputation may be done at once or by making notches on one or both sides of the pedicle, thus gradually cutting off the circulation at various intervals. After the pedicle has been cut through, the free end of the flap should be fitted to its proper place at once and, whenever possible, the stump of the pedicle should be returned to its original bed, as in this way a better result can be obtained with little, if any loss of tissue.

Flaps of normal skin are often successfully shifted into the midst of scar tissue, as in the popliteal and cubital spaces, but one should make sure that the circulation of these flaps is especially good.

Immobilization of the part is essential. The dressing next to the transplanted area should be soft and very carefully and evenly applied. My own preference is for the use of compresses wet with normal saline solution for the first 48 hours. In shifting double-pedicled flaps on the neck or from the neck to the chin or lip, it is advisable to provide for drainage with a small protective wick in each lower angle.

The flap should be inspected frequently, as the evacuation of collection of serum, the combating of a slight infection, or the loosening of tight stitches may change into a success what might otherwise prove a failure.

Occasionally it may be necessary within the first 48 hours to shift

the flap back to its original position, when for one reason or another its death seems imminent.

Skin flaps may be turned into the mouth to take the place of destroyed mucous membrane. Flaps may also be inserted by tunneling under normal tissue. This may be done with the ordinary pedunculated skin flaps or with island flaps.

Double pedicled "gauntlet" flaps raised from the chest, abdominal wall, back, or thigh, are often used for the repair of lesions involving the hand or fingers. The flap is raised, the part is slipped beneath it and is immobilized. After the blood supply has been assured the pedicles are cut, either both at one time, or separately, and the edges of the flap are sutured into position.

The transplantation of flaps whose pedicle consists practically of only the temporal artery and veins, was reported by Monks in 1898. He constructed a new lower-lid by using a crescentic-shaped flap of the skin of the forehead, into which ran the anterior temporal artery. He then dissected out the artery and accompanying veins and, after tunneling, passed the flap through and sutured it in position, thus leaving the vessel under the skin. Horsley, in 1915, suggested a somewhat similar procedure for repairing a cheek defect, not being aware of Monks' report. He did not use the tunnel method, but implanted his vessels in an incision which was closed over them. The principle was the same, although the size of the flap and the technic were different.

If by chance the nerve which supplies the portion of the skin which is used as a flap should pass through the pedicle, the sensation remains in the flap until the pedicle is cut, but afterward for the time being the sensation is cut off. After five or six weeks sensation begins to return because the nerve supply comes in from the periphery, as in whole-thickness skin grafts. The flap regains tactile sensibility first, then pain, and finally temperature sense. If the flap is large, the central portion may not regain its sensation for a considerable time.

In my last two rhinoplastic operations by the Indian method, the pedicle contained the left angular artery, and evidently an undisturbed nerve supply, for when the stitches were removed along the alæ and columna, both patients complained of pain high up on the forehead. This sensation was frequently tested and continued for several weeks, until the pedicle was cut, after which all sensation was temporarily eliminated.

Grafts of all types may become pigmented, but pigmentation

seldom occurs in pedunculated flaps, and for this reason they are to be preferred on the face and other exposed positions.

In addition to the use of the ordinary skin and subcutaneous fat flap, pedunculated flaps of other tissues may be used in reconstructive surgery.

Mucous Membrane.—Pedunculated flaps of mucous membrane, when available, may be used with satisfaction for filling in lip and cheek defects.

Fat.—Pedunculated flaps of fat are often used to fill defects in bone to raise depressed scars, to surround tendons and nerves, and to prevent adhesions. It is also used in joints, but the combined fat and fascia flap is superior in arthroplastic operations.

Muscle.—Pedunculated flaps of muscle are used to fill defects in bone, as after mastoid operations, and to fill out depressions, for example, those caused by the destruction of the malar bone in war wounds.

Fascia.—Pedunculated flaps of fascia are often used with success to reinforce weakened tissue, for instance, in hernia operations.

A review of the literature shows that during the last hundred year practically every portion of the surface of the body has been repaired by means of pedunculated flaps for the relief of defects, either congenital or acquired.

The use of the pedunculated flap of skin with the required amount of fat is one of the most dependable methods at our command for the repair of tissue defects. It is especially useful in repairing defects opening into the mouth, nose, bladder or vagina. No other surgical procedure is so effective in bringing about permanent elastic healing in areas exposed to constant trauma, as around joints, on the soles of the feet, and elsewhere.

A pedunculated flap with good circulation will live and succeed in positions in which free transplants are contraindicated. The neglect of this valuable surgical measure is quite general among surgeons, but its many advantages should assure its constant employment in suitable cases.

By the use of pedunculated flaps not only may function be restored but also cosmetic results be obtained in many cases otherwise beyond the help of surgical procedures.

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CHAPTER VII

THE TREATMENT OF WOUNDS

GENERAL CONSIDERATIONS

It may be thought by some that a consideration of the treatment of wounds is out of place in a work on plastic surgery. Nevertheless if we bear in mind the fact that it is often of vital importance to the ultimate result, that either healing take place before a plastic operation can be safely done, or that a granulating wound must be brought into a healthy condition before skin grafting can be carried out, the necessity for a full understanding of the subject on the part of the plastic surgeon will be readily appreciated.

The treatment of wounds is an unending source of interest, and one of the most fascinating subjects for study in the entire field of surgery. In the following pages I shall not attempt to cover the multitudinous methods that have been advocated, but shall consider only those which I have used and which seem to be of interest at this time.

The treatment of wounds is not a simple matter, although until the beginning of this war little attention was paid to wound treatment by the ordinary operating surgeon, unless he was especially interested in some special phase of the process. Dressings were, as a routine left to the care of the student dresser, or to the interne, even in the most extensive cases. But the vast numbers of wounded in this great war have again stimulated interest on the subject, and it is now conceded that in the majority of surface wounds the good results obtained are dependent largely on the skill with which they are handled.

The main object in the treatment of all wounds, whatever the method used, is to put them in the most favorable condition for healing.

Each individual granulating surface wound should be studied separately inasmuch as no single routine method of treatment has yet been found which is equally efficient in every case. Granulating wounds should be dressed frequently, and the best results are obtained when the treatment is varied.

I shall not consider the histological changes which take place in the healing of wounds, as these changes are familiar to every one. The

efficiency and skill of a surgeon may be judged quite accurately by observing him as he does a difficult dressing.

It must be impressed on every student and interne, and be remembered by the more experienced surgeon that all dressings should be done with exactly the same consideration for the comfort of the patient, and the safety of the tissues, as the dresser would desire if he himself were the patient.

It is quite difficult to determine the true value of the various methods of wound treatment, both on fresh wounds and on chronic ulcers. One surgeon may obtain good results in a certain way, whereas another using the same method, may find the results unsatisfactory. This difference may be due entirely to the careful handling of the growing tissues in one case, and to careless treatment in the other, the method itself actually having little to do with the results obtained.

The most satisfactory way of making a comparison of different methods of treatment is to have the same surgeon treat different wounds on the same patient by different methods. This, however, is not always possible to do. But whatever the method of treatment used, it is an established fact that better results are always obtained by surgeons as they become more experienced in the actual handling of wounds.

The general condition, the surroundings, and even the mental attitude of the patient must be taken into consideration, as these are important factors where methods are to be compared. The location and the vascularity of the part, the degree of trauma of the soft parts and the extent and kind of infection, must also be considered.

Often the tissues around the wounds are more or less infiltrated with scar, and this is a most important factor, as it makes the problem of wound healing and operative procedure, much more difficult.

Recent Wounds

It is imperative to inject a prophylactic dose of 500 units of tetanus antitoxin as soon as possible after the wound is received, and a similar dose after ten days, unless the wound is very slight.

In time of peace the plastic surgeon is seldom called upon to treat recent wounds. In time of war, however, such wounds of the face are frequently referred to him, and these may be divided into two general groups.

GROUP 1.—*Cases in which there is injury to the soft parts alone.*

This group may be subdivided in (a) those in which the tissues are cut or lacerated, but where there is a possibility of replacing and suturing them, in more or less normal position. (b) those in which there has been extensive destruction of the soft parts with no possibility of immediate closure.

GROUP 2.—*Cases in which there is injury or destruction of the bone*
The bone injury may be associated with conditions belonging to either of the subdivisions spoken of in *group 1*.

GROUP 1, a.—*When the soft parts may be approximated*, it is important to suture the tissues as soon as possible after disinfection with ether (preferably) or iodine, and if necessary excision of devitalized tissues.

Valadier and Whale say that "however dirty the wound, it should be closed within a few days, and long before it is thoroughly clean." Perfect asepsis is unattainable, inasmuch as most of these wounds open into the mouth.

It is best to suture these wounds in layers; the mucous membrane separately, if possible, with catgut, then with buried sutures of catgut for the muscle and fascia layer, and with silkworm-gut or horsehair for the skin. The deep sutures may occasionally enter the mouth if necessary, and may even be tied there. All of these sutures should be inserted at a considerable distance from the wound margin. To reinforce these layers wide tension sutures of silkworm gut may be used tied over lead plates or vulcanite buttons.

When laceration is present, it is unwise to attempt to bring the parts into perfect approximation, because the tension on the suture may hasten a break down. Infection often occurs in these wounds and may cause the superficial sutures to break down within a few days, but usually they hold until the deeper layers have granulated.

GROUP 1, b.—*When there is extensive destruction of the soft parts*
often but little can be gained by drawing the edges toward each other with sutures, nevertheless, properly placed tension sutures may aid in preventing contracture. Every particle of tissue not obviously dead should be preserved, more especially if it be mucous membrane. When the destruction of the upper or lower lip or cheeks has been sufficient to prevent approximation the mucous membrane should be sutured to the skin, and the plastic operations for permanent closure be deferred until later.

The object of these procedures is to aid in the prompt healing of the wound, and to prevent unnecessary contracture. Those parts

which are difficult to reconstruct (such as the columna and ala of the nose) should be most carefully preserved.

Before anything further can be accomplished with safety, it is necessary to overcome infection, and allow healing to take place. Then, by the selected plastic, or series of plastic operations, the defect may be closed with flaps of living tissue either from adjacent or from distant parts, as seems most advisable.

GROUP 2.—*When there has been fracture or destruction of the bone, but when closure of the soft parts is still possible*, the ideal method of treatment is the application of a temporary prosthesis, in order to immobilize the bone fragments, after which the soft parts should be sutured over it as described for Group 1. A permanent supporting structure may then be made, or, after the wound is in condition, bone or cartilage may be transplanted to fill the defect.

In cases in which destruction of the soft parts is so extensive as to prevent closure, and there is bone destruction also, it is advisable to insert the proper dental appliance at once, to keep the remaining bone fragments in position, and to prevent unnecessary shrinkage of the soft parts. After this the treatment is that of Group 1. After healing of the soft parts has taken place, a plastic operation to close the defect should be done, with the prosthetic appliance in position. Subsequently a bone or cartilage graft may be inserted in the bone defects, unless it appears wiser to depend on the permanent artificial support. Earlier in the war, when this was not done, it was found that the splints could not be applied later, on account of contraction of the soft parts. In many of these cases the soft parts had to be reopened before the necessary apparatus could be applied, but even then the obliteration of the buccal sulcus and contraction of scar tissue limited the function of the jaws permanently.

Wounds of the face cannot be treated by complete excision as readily as those in other portions of the body. Nevertheless, all tissue that is without vitality should be excised. All foreign bodies and unattached splinters of bone should be removed. Hemorrhage should be checked. Every particle of bone, however small, which is still attached to its periosteum should be conserved, and as much of the mucous membrane as possible. All teeth should be preserved for supporting purposes.

Wounds leading into the mouth or nose are especially difficult to keep clean, and in these cases free drainage should be provided through the floor of the mouth, in the mid-submaxillary region, if openings in dependent portions are lacking.

Frequent irrigations with Dakin's solution, weak peroxide, normal salt or boric solutions, Wright's solution, or permanganate of potash are important. Mouth washes should be used, and every effort should be made to overcome infection and promote healing. Dichloramine-T applied on swabs, or as a spray, is often useful.

Much has been done to overcome infection, and to promote primary healing in war wounds, but probably nothing has as yet given the rapid results, in selected cases, that have followed *débridement* or excision of the wounded area, as used by the surgeons at the Front.

I shall consider this method only in so far as it may apply to plastic work.

A. Depage (one of the earliest and most enthusiastic advocates of the method) has covered the ground thoroughly, and the following remarks on *débridement* are based mainly on his ideas.

Some surgeons have advised the excision of the wounded area *en bloc* but this is only possible in comparatively short superficial tracts and not in the long deep tortuous wounds so often found.

Before proceeding to a *débridement*, the surgeon should acquaint himself, as exactly as possible, with the situation of the tract in its relation to the different anatomical structures. The direction of the incisions should vary with the region implicated and with the nature of the wound.

In a superficial wound the two orifices should be excised, and the bridge of interposed tissue divided, transforming the tract into a furrow. After this the sides or floor of the furrow are completely excised. Should the wound be deep, every portion of it should be carefully explored, and all foreign bodies and devitalized tissue removed. Muscles should be divided transversely, when it is necessary to give proper exposure.

After *débridement* the continuity of the muscles should be immediately reestablished by means of mattress sutures of catgut, but if any doubt exists as to the condition of the wound, the muscle suture may be delayed for two or three days. Nerves and vessels should be preserved when muscles are divided transversely.

The Suturing of Wounds.—The suturing of the wound may be done immediately after *débridement*—*the primary suture*.

It may be done during the first five or six days—*the delayed primary suture*. For this as in the primary suture, the edges are simply brought together.

The suturing may be performed after chemical sterilization of the wound by Dakin's solution—*the secondary suture*.

The time for making the delayed or retarded primary suture is determined by bacteriological control. At the first dressing from 12 to 24 hours after the débridement, a smear and culture are taken. At the second dressing, from 36 to 48 hours after the débridement, the process is repeated. If the first culture does not show any streptococci, and the bacterial count in the last smear does not exceed 1 for every 2 fields, the wound is sutured.

THE RETARDED PRIMARY SUTURE should not be employed after the second dressing, if the bacterial count shows an increase, even if no streptococci have been demonstrated in the culture. The use of the retarded primary suture rarely brings about failure with serious complications, but it involves the inconvenience of two operations.

THE SECONDARY SUTURE is reserved for wounds which cannot be sutured during the first few days, owing to a too widely injured area or to a threatened infection. It is a safe, but slow method, and never gives as good a functional result as the primary or the delayed primary sutures. It should be practised regularly when the bacterial control remains below 1 for every 4 fields, and after two successive cultures have showed no streptococci.

Dressings for Sutured Wounds

In many instances a carefully sutured wound may be exposed to the air either without dressings, after being painted with tincture of iodine, or after being dusted with calomel, subiodid of bismuth or some other powder.

Silver foil, first suggested by Halsted, has never been improved upon as a dressing for clean sutured wounds. It has a slight antiseptic action. In wounds around the mouth and nose the application over the suture line of compound tincture of benzoin, which has been evaporated to a thin syrupy consistence (suggestion by E. H. Ochsner) has proved very satisfactory, and by its use many infections may be avoided. Gauze wet with normal salt solution, or with a watery solution of iodine (1-500) may be used next to the wound, and allowed to dry out.

When wet dressings are indicated (as in the transplantation of flaps, or where infection is feared), in my own experience gauze wet with a saturated boric-acid solution or normal salt solution, and kept wet for varying periods, has proved satisfactory.

Granulating Wounds

In time of peace wounds which are referred to the plastic surgeon are, as a rule, of two kinds: (1) *Extensive wounds due to burns or trauma*, involving the destruction of the entire thickness of the skin and often some of the underlying soft parts, whose size or position necessitates skin grafting or plastic operation, in order to ensure a rapid stable healing.

(2) *Intractable wounds or ulcers*, which have resisted all the usual methods of treatment.

Many of the wounds in *Group 1* are due to burns, and for the sake of clarity I shall classify burns as follows:

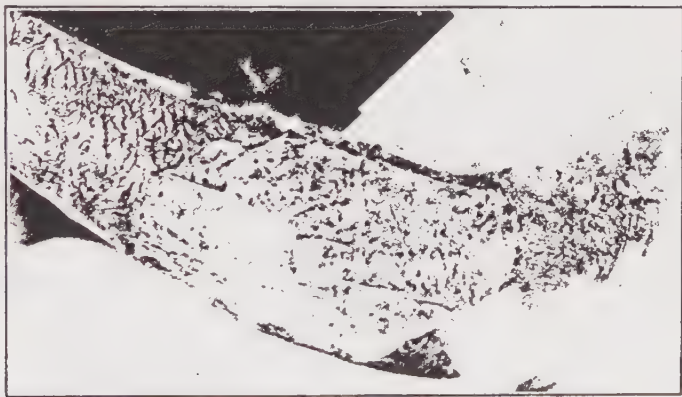


FIG. 114.—Second degree burn of the forearm. Duration 3 days.—The extent of the large blister which has been opened in several places under aseptic precautions is shown by the white area. No infection occurred and the blistered skin was not removed. A portion of it adhered to the wound much like a thin graft, and a portion dried and was removed

FIRST DEGREE BURNS, where the skin is reddened.

SECOND DEGREE BURNS, where the skin is blistered.

THIRD DEGREE BURNS, where there is destruction of the entire thickness of the skin, or of the skin and deeper tissues.

SHELL GAS, "MUSTARD GAS" BURNS (DICHLORETHYLSULPHIDE).—Burns caused by this gas were practically unknown before the introduction of this barbarous method of warfare by the Germans. They may occur during its manufacture, but much more commonly in gas attacks. The majority of these burns are superficial, but occasionally there is destruction of the skin and the underlying tissues to various depths producing a tendency to great sluggishness and successive layers of sloughing.

The insidiousness of the gas and the difficulty in handling the burns without causing further damage to both attendant and patient from the contents of the blisters makes the early care quite trying.

It is hoped that this type of burn will hereafter be practically eliminated, and that the manufacture and use of "mustard gas" will now cease for ever.

Recent burns seldom come under the care of the plastic surgeon. These cases are usually referred to him when they have become granulating wounds, therefore I shall consider burns only from that standpoint.

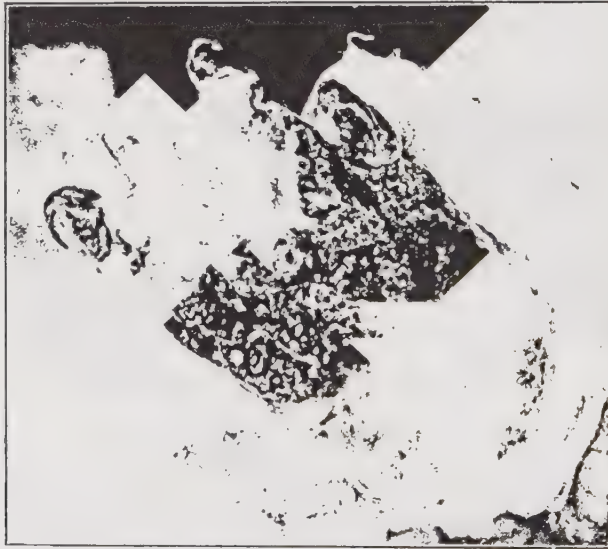


FIG. 115.—A crush burn of the palm of the hand and fingers. Duration three weeks. The deep destruction of tissue would eliminate the successful use of a thin graft in this case, except as a preliminary measure. The only chance of restoring function is to cover the palm and fingers with pedunculated flaps of skin and fat.

The Care of the Skin Surrounding a Wound

The care of the skin surrounding a wound is important, as its healthy condition means much in the healing process. If the skin is infected, or irritated, it is difficult to put the wound in a healthy condition, and in addition the dressings are seldom comfortable.

Irritation may be caused by wound secretions, by the drugs applied, or by the constant use of adhesive plaster in the same places. Ether, benzine, or gasoline are probably the best solutions for cleansing the skin immediately surrounding the wound, as they remove secretions and

oily substances and do not irritate. The skin surrounding the entire part should be sponged with alcohol and gently massaged, if possible every day.

In ulcers, or in fact in any wound, in which the secretions or type of dressings are liable to cause irritation, I anoint the skin for several inches around the wound with some bland ointment, preferably zinc oxid in benzoinated lard (U.S.P.). Lanolin and liquid paraffin may be successfully used for the same purpose.

The use of a mixture called "Steroline," a sherry-colored fluid, with a pleasant odor, having the formula, Balsam of Peru 4 c.c.; castor oil and Venetian turpentine of each 2 c.c.; alcohol (95 per cent) 100 c.c. was first reported by R. Frank. It is intended to be used as an emergency method of cleaning the patient or the hands of the surgeon. It leaves a very thin, shiny, dry coating on the skin, which sheds water. I have used Steroline in the out-patient department for several years both to protect the skin around wounds, and to protect my hands, and have found that it is non-irritating and leaves the skin soft. I have not felt justified in using it in hospital practice instead of rubber gloves and the standard methods of cleaning the skin. Steroline is also an excellent dressing for first-degree burns, it relieves the pain and reduces inflammation.

The Avoidance of Pain During Dressing

Pain during dressings is, of course, unavoidable in some instances but with the various means at our command much can be done to reduce it to a minimum. Every care should be taken to avoid dressings which stick closely to the granulations, as their removal necessarily causes pain and, furthermore, does great damage to the granulation tissue and also to the epithelium growing in from the edges.

It is a good rule never to put loose-meshed dressing gauze immediately in contact with a surface wound, unless it is either smeared with some ointment, soaked in oil, liquid paraffin, or in melted ointments, or is kept constantly wet. Very active wound secretion will also prevent sticking. It is obvious, also, that raw cotton should not be placed on an unhealed surface.

Should the granulations grow into the mesh of the gauze, or the dressing become adherent, it is advisable to apply a liberal amount of sterile vaselin over the gauze next to the wound, and finish the dressing 24 hours later. During this time the vaselin will soak into the gauze

over the wound, and it will be found that the dressing may then be removed without pain or bleeding. The same purpose may be accomplished more rapidly by saturating the gauze with sterile oil (cottonseed or olive oil) or with liquid paraffin, and then by lifting up the edges and dropping in more oil the gauze can be removed without difficulty.

Peroxid of hydrogen is also useful for loosening gauze, but my preference is for the oil.

Anesthesia in Painful Dressings.—I have seen it necessary, in certain very painful dressings, to use general anesthesia (usually nitrous oxid and oxygen), but this is rarely necessary in civil practice.

Hirschman says that in some hospitals at the front, in dressing painful wounds when anesthesia is required, it is safely produced by the following mixture: Ethyl chlorid 5. c.c.; chloroform 1. c.c.; ether 24. c.c.

He describes its use as follows: A piece of flannel cloth is saturated with the entire mixture, and is placed over the patient's face. This is covered with another piece of flannel, and this in turn with oiled silk, containing a small opening over the nostrils. The whole is tied around the patient's face, with a piece of tape or rubber tubing. The anesthesia produced will last for 10 minutes and the dressing can be started on the second breath. This anesthesia is apparently devoid of danger of any sort, and is welcomed by the patient. Dineen describes a similar method with the following mixture: chloroform 2. c.c.; ether 18. c.c.; ethyl chloride 10. c.c.

Method of Sponging a Granulating Wound

After the dressing is off, the wound should never be rubbed with pledgets of gauze or sponges, as pain is caused and much damage may be done to both the granulation tissue and to the growing epithelium. The pledgets should be pressed down gently on the surface, and it will be found that the secretions can be removed as thoroughly by this method as by wiping or rubbing. The surrounding skin may be rubbed vigorously, but it is needless to say that no sponge or pledget with which the skin has been rubbed should be applied to the wound.

The Protection of Granulations

Paraffin Mesh.—Various methods have been devised to prevent dressings from sticking to granulating wounds. Linen, chiffon silk, paper soaked in oil or spread with ointments, were first used. Later oiled silk was devised by Lister, and subsequently a thin gutta-percha

"protective" was devised by Dr. W. S. Halsted, the latter now being the standard for surgical use.¹ Waxed or paraffin paper (either plain or perforated) has been used for many years for the same purpose, but is unsatisfactory, as it tears so easily. The fabrics or protective, if used next to the wound, should be perforated, or V-shaped slits be cut, to allow the escape of secretions. All these methods are efficient.

It has been found that the use of some meshed material (such as mosquito-netting, or material with larger openings), which is impregnated with paraffin or gutta-percha, will prevent sticking. For ordinary purposes I prefer the mesh with openings 1 cm. ($\frac{3}{8}$ inch) in diameter, impregnated with rubber as previously described. This mesh can also be impregnated with paraffin.

A number of methods of preparing mosquito-netting by impregnating it with paraffin have been described. The following method is simple and satisfactory.

Cut the mesh into the desired sizes. Melt the paraffin (Carrel's mixture, Ambrine, Stanolind wax, or any of the new mixtures) over a water bath. Saturate the mesh with the melted paraffin, remove the mesh from the paraffin, and wrap each piece (or as many as may be desired) in waxed paper, and then in a double muslin cover. Sterilize with the other dressings. The sterilization will remove the films of paraffin from the openings in the mesh, and will leave sufficient in the mesh itself to prevent sticking.

The paraffin mesh is most useful on any granulating surface, and will prevent injury to the granulations and to the growing epithelial edges, when the dressings are changed.

For impregnating the mesh Dodd used a mixture of pure paraffin and petrolatum, each 2 parts, with 1 part of stearin. H. E. Fisher prepared a non-adherent gauze by saturating it with a mixture of paraffin, 8 parts, petrolatum or lanolin 2 parts. I have used for years gauze saturated with liquid petrolatum either plain or with iodine, 1-300 (iodine 1 gm.; liquid petrolatum 300 c.c.) as a non-adherent dressing, and also gauze saturated with sterile castor oil, for the same purpose, and find them very useful.

¹ On April 11, 1912, Dr. Halsted in his clinic said, that in the early eighties ('80 or '83) when searching for some thin, reasonable priced, oiled cotton material to take the place of Lister's green oiled silk for dressing wounds, he came across a thick gutta-percha tissue used at that time as rubber sheeting is now used, and was told by the manufacturers that he could have this made as thin as desired. He experimented with many different thicknesses until finally the desired degree was obtained, and from this came the protective of the present day.

I have also used perforated sheets of thin celluloid, which has the advantage of being transparent, and can be obtained in any size desired. E. O. N. Kaire calls attention to the use of sheet mica as a protective non-adherent, non-irritating dressing, which is transparent, and can be sterilized by dry heat, but only comparatively small sheets can be obtained.

Exuberant Granulations

Exuberant granulation tissue is sometimes difficult to deal with, especially if the patient is in bad condition and the wound is painful. The best procedure, and one which causes surprisingly little pain, is to trim the granulations off to the level of the skin with curved scissors. The raw surface should then be washed with normal salt solution and dressed as desired.

The granulations after being dried may be cauterized with silver nitrate stick, or with the saturated solution. Compresses of iodoform gauze wet with glycerin are useful in reducing granulations. Exposure to the sun or electric light, is an efficient method. Granulations may also be reduced by the use of Dakin's solution, or of Dichloramine-T. When Dakin's solution is used granulations never become exuberant.

The Chlorin Antiseptics

In order to prepare a wound for secondary suture, or to put it in condition for skin grafting, or to bring about the maximal speed in unaided cicatrization, some method must be used which will disinfect the wound and bring down the bacterial count.¹

The rehabilitation of the chlorin germicides by Dakin, and the evolution of the elaborate technic necessary for the use of the hypochlorite solution by Carrel, has done much to solve this problem.

Early in the war opinions as to the possibility of chemical sterilization of an infected wound were divided. Sir Almroth Wright held

¹ My attention was first called to the value of Labarraque's solution (*Liquor sodæ chlorinata*) many years ago by Col. Wm. B. Davis, M. C., U. S. Army. I have often used it since in the treatment of sluggish and infected ulcers in strengths of 1-8 or 1-10 in water, for saturating compresses which should be changed every two hours. My results have been excellent. It is necessary to protect the surrounding skin from irritation with vaselin or zinc ointment. Labarraque's solution (the original chlorin antiseptic) was studied by Dakin and Lorraine Smith, who found that the irritation of the skin was due to the alkalinity of the solution. They were able to neutralize this by the addition of certain salts and thus to reduce the irritating effect of the solution. It was from this that Dakin developed the solution which now bears his name and is in such common use.

that this method was impracticable without injury to the tissues, and thought that the best results in treating infected wounds could be obtained from the use of hypertonic salt solutions of varying strength.¹

Dakin's Solution.—It has been proved beyond question that chemical sterilization of infected wounds is practicable, and Henry D. Dakin found that a solution of hypochlorite of soda (0.48 per cent), which has been neutralized with boric acid and which remained nearly neutral under all conditions, would destroy bacteria and neutralize the toxins without harming the tissues.²

In order to maintain the needful strength of the solution, which lessens rapidly with the dilution by the wound secretions and by the combination of the hypochlorite with the proteins, it is necessary to

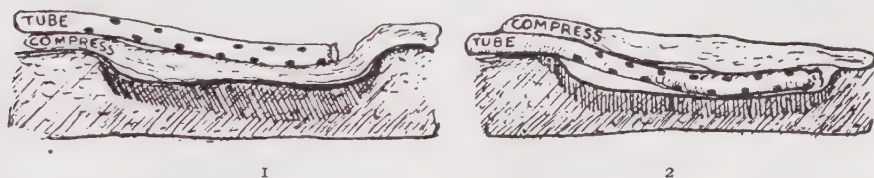


FIG. 116.—Arrangement of Carrel's tube for the instillation of Dakin's solution on a horizontal wound. (*Carrell and Dehelly.*)—1. The wrong method of placing the instillation tube. The tube is on the surface of the compress. 2. The right method of placing the tube. The tube is in contact with the wound and covered with the compress.

keep it constantly renewed. This is best accomplished by intermittent instillation.

It has been found that the most practical method of application is to allow small rubber tubes from 30. to 40. cm. (12 to 16 inches) long, perforated with minute holes from 0.05 to 0.1 cm. (about $\frac{1}{50}$ to $\frac{1}{25}$ inch) to lie on the tissues. The disposal of these tubes varies with the shape and size of the wound, but they should be so placed that the solution will be brought in contact with every part of the surface. Tubes having the perforated portions covered with turkish toweling are best adapted for surface wounds without much discharge. The instillation may be made by means of a syringe, or of a reservoir with a pinch-cock, the latter being the instrument of choice (Figs. 116–118).

As soon as the tubes are in position and are secured by strips of

¹ WRIGHT'S SOLUTION.—Sodium chlorid 4 or 5 per cent and sodium citrate 1 per cent, in water.

² For a full consideration of the elaborate technic developed by Carrel in using Dakin's solution, and the preparation of this solution, the reader is referred to Child's translation of Carrel and Dehelly's "The Treatment of Infected Wounds," and Dakin and Dunham's "Handbook of Antiseptics."

erile adhesive plaster, the surrounding skin and dependent portions likely to become wet are protected from erosion or irritation by squares of gauze (8. or 10. cm. ($3\frac{1}{2}$ or 4 inches) which have been sterilized in vaselin or in a mixture of zinc oxid 100 parts, vaselin 400 parts, and arawax, 5 parts (Rockefeller War Demonstration Hospital). Compresses soaked in Dakin's solution are then applied over the tubes,

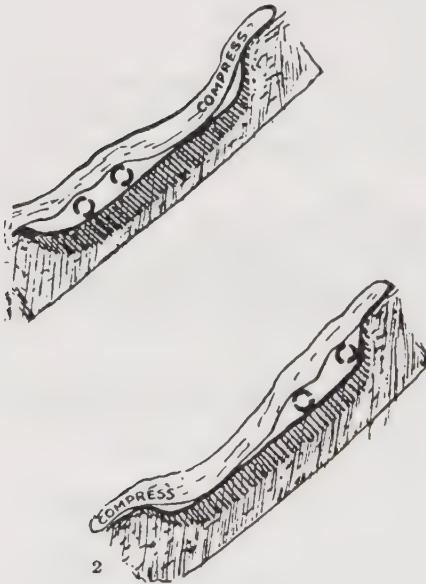


FIG. 117.

FIG. 117.—Arrangement of Carrel's tubes for the instillation of Dakin's solution on a wound with surface inclined. (*Carrel and Dehelly.*)—1. Tubes placed the wrong way along the lower border of the wound. 2. Tubes placed the right way along the upper border of the wound.

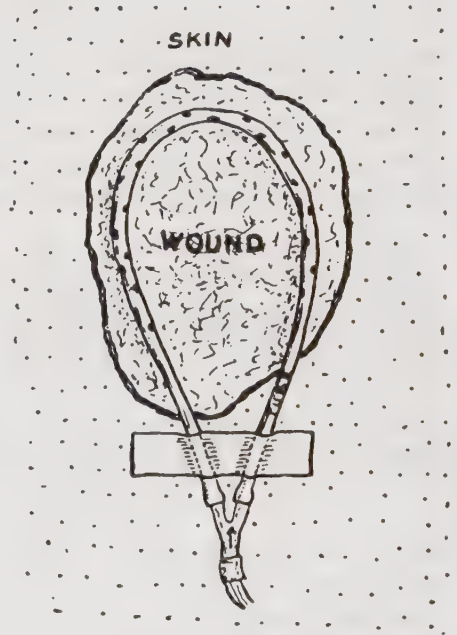


FIG. 118.

FIG. 118.—Method of instilling Dakin's solution with a circular tube on a surface wound.—(*Carrel and Dehelly.*)

over which is laid as an outside protection a cotton pad, the absorbent portion being next to the wound.

Immobilization is imperative. The dressing should be changed every 24 hours. From 10. to 20. cm. (4 to 8 inches) of the unperforated portions of the rubber tubes extend from the dressings, and their ends are connected with the reservoir. The pinch-cock is opened for a few seconds every two hours, and from 20. to 100. c.c. of the hypochlorite solution are allowed to flow over the wound. The height of the reservoir is from 40. to 100. cm. (16 to 40 inches) above the wound, depending on the pressure desired.

The instillation continues day and night until all bacteria have disappeared from smears. As long as a few colonies remain, no alteration should be made in the quantity or frequency of the instillation.

This brief outline of the technic will give some idea of Carrel's method. No surgeon should attempt to use it without very careful study of Carrel's instructions, or better still, after a course in the method such as was given in the Rockefeller War Demonstration Hospital to the officers of the Medical Corps.

In general, from 3 to 10 days are needed for the sterilization of wound, but when it has already been suppurating before the beginning of the treatment, a much longer time may be required. Bacteriological examination alone should indicate when the instillations may be discontinued.

Wounds, although clinically identical in appearance, may show marked differences in the bacterial count. Five or six bacteria to a field can retard the rapidity of cicatrization by nearly one-half, as compared with the cicatrization of a similar but sterile wound. It is impossible to tell by the appearance of a wound whether it is sterile; hence, a knowledge of the bacteriological conditions is imperative.

Surgeons who have used Dakin's solution, while practising the careful observation of the Carrel technic, are almost unanimous in saying that devitalized tissue is dissolved, that infection can be controlled by it more promptly than by other methods, and that the bacterial count shows immediate and constant diminution.

The poor results reported have been probably due to the omission of some important point in the technic, since absolute adherence to every detail must be insisted on, if the best results are to be expected.

My own experience with this method has been very satisfactory in surface wounds, such as are referred to the plastic surgeon, and my remarks on the chlorin antiseptics deal with them only from the standpoint.

There are certain disadvantages in the use of the hypochlorite or soda solutions. The solution must be prepared with extreme care, and preferably should be made fresh each day, although it will keep for a week or more.

The hypochlorite solution will irritate the skin, if the latter is not carefully protected. Only a 0.48 per cent solution of the hypochlorite can be used without causing irritation.

Eusol.—Another solution of chlorin for war wounds is the so-called *Eusol* (Edinburgh University solution), which may be used on comresses, or by the Carrel technic.

A mixture of equal parts of boric acid and dry bleaching powder (chlorinated lime) is made, and kept in a tightly stoppered bottle. This is called *Eupad* powder. *Eusol* (which contains the equivalent of about 0.27 per cent hypochlorous acid) is made by taking 25 grams of *Eupad* powder to one liter of water. The flask is well shaken and left standing for several hours; the solution is then filtered and is ready for use. It has been used extensively by English surgeons, and excellent results have been obtained. I have found that patients complain of more burning and discomfort in the wound itself when *Eusol* is used, than when Dakin's solution is instilled.

P. Duval, after long experimentation, found that Wright's hyper-tonic solution cleared up wounds with gangrenous surfaces in from 36 to 48 hours, which is a quicker result than can be obtained with other methods, and this has also been my own experience. After this length of time however, Dakin's solution, ether, or the sun's rays, give more rapid sterilization than a continuation of Wright's method.

DICHLORAMINE-T (Toluene-para-sulphondichloramine)

It was found that Dichloramine-T also was a powerful germicide, and that when dissolved in *chlorcosane* (a chlorinated oil), it could be used in a much stronger concentration than was possible with Dakin's solution.

Dichloramine-T in this way can be used in from 5 to 20 per cent, preferably 7.5 per cent solution. It is sprayed over the wound with a glass atomizer, or may be applied with a (dry) medicine dropper or a glass rod.

No watery or alcoholic solutions should be allowed to come in contact with the wound, since these fluids decompose the substance. If cleansing is necessary, sterile alboline, benzine or ether may be used.

In Dichloramine-T we have a chlorin antiseptic which is easy to prepare. The technic is simple. The dressings are done once in 24 hours, and are inexpensive, only a small amount of gauze being used. No special apparatus is necessary. There is no irritation to the skin if the chemicals are properly prepared, although it is from 10 to 40 times stronger than Dakin's solution.

The results on surface wounds are good, and it is especially valuable

in cases in which the use of the more complicated technic of Carrel with Dakin's solution is impracticable. Its action on necrotic tissue is not as marked as the hypochlorite solution, although it has the power of dissolving dead tissue. Excellent reports on its efficiency in the treatment of war wounds by Sweet and Hodge, and others, and in the work of Lee and Furness who used it on infected wounds in civil practice, testify to its worth.

My own experience with Dichloramine-T in the Out-patient Department of the Johns Hopkins Hospital has been quite satisfactory. The rapid drying out of the granulations, and the small amount of discharge, being especially noticeable.

In this antiseptic we have a substance which can be used with special advantage in the Out-patient Service. It is clean and economical, and certainly aids in the disinfection of infected wounds. One is struck by the lack of disagreeable odors when visiting a ward in which any of the chlorin antiseptics are being used, and this deodorizing feature alone would make the use of these substances well worth trying.

There is a wide field for the use of chlorin germicides. In extensive-deep wounds, Carrel's method of using Dakin's solution is undoubtedly the best, but in many instances in which it is impossible to carry out this technic, Dichloramine-T may be used with satisfaction.

Quino-formol.—Pilcher has recently reported the effect on war wounds of a solution called quino-formol, which is applied by the Carrel method. The formula is as follows: Quinin sulphat 1.gram; hydrochloric acid 0.50 c.c., glacial acetic acid (99 per cent) 5.00 c.c., sodium chlorid 17.50 grams, formol (40 per cent) 1.00 c.c., thymol 0.25 grams, alcohol (90 per cent) 15.00 c.c., water q.s. ad 1 liter. (1) Dissolve the quinín in the hydrochloric and acetic acids; (2) dissolve the sodium chlorid in the water; (3) dissolve the thymol in the alcohol. Add No. 1 and No. 2, then the formol and finally the thymol solution.

The hydrochloric acid, as noted in the formula, is used to put the quinín in a more perfect solution; the acetic acid for its action with the quinín solution, giving a solvent and analgesic effect; the sodium chloride for its dehydrating properties; the formol for its bactericidal and fixing properties, as is the alcohol, which is used to put the thymol into solution.

Among the many advantages claimed are, that the solution is stable, is easily prepared, and can be used in the evacuation hospital. The wound is rapidly sterilized and epithelization is stimulated. The solution has no proteolytic properties and if there is deposition of

fibrin, then Dakin's solution should be used until the wound is clear of detritus.

I have had no personal experience with this solution, but such excellent results are reported that it seems well worth a trial.

Ointments

The ointments most commonly used on granulating wounds are, boric acid (10 per cent), balsam of Peru (20 per cent), salicylic acid (2 to 5 per cent), ammoniated mercury (10 per cent), blue ointment (33 per cent), iodoform ointment (10 per cent), zinc oxid ointment (20 per cent), either in vaselin or in benzoinated lard. I often use a thick paste of bismuth subnitrat and castor oil and find it a valuable dressing. The ointments should be applied on old linen, or close meshed gauze, and should not extend more than 2.5 cm. (1 inch) beyond the wound edges.

Powders

Powders are used for hastening the drying of surface wounds; for dusting over sutured wounds, for preventing maceration in skin folds, and protecting the skin from secretions. Unless a wound is very superficial, I scarcely ever use powder of any sort, as crusts form, and if the wound is large it is hard to prevent absorption from the secretions which collect beneath the crusts. I have found the use of powder much less satisfactory than exposure to the sun or electric light, and in the latter case the wound is not clogged to the same extent.

The most satisfactory use of powder is for the protection of the healthy skin, and for this purpose I use the ordinary talcum, or stearat of zinc powder, the former to dust over the skin, more for comfort, and the latter, which is an oily powder, to protect the skin from secretions and from maceration. Calomel powder, or subiodid of bismuth, may be used on a sutured wound which is exposed to the air, and I occasionally use bismuth subnitrat, bismuth subgallat, iodoform, and boric powders, either alone or in combination.

Medicated Gauze

Gauze impregnated with iodoform, bismuth subnitrat, or balsam of Peru, are those commonly used for surface wounds.

I have had very satisfactory results in clearing up infected surface

wounds by the use of gauze saturated with a mixture of camphor 5 parts, pure carbolic acid 49 parts.

Wet Dressings

Many solutions have been used for irrigations, and for wetting gauze dressings. Among them, normal salt; Ringer's; Wright's; sterile water; saturated boric; Dakin's hypochlorite of soda; acetate of aluminum 2 to 5 per cent; benzoic acid 2 per cent; glucose 48 per cent iodine 1-500 (tincture of iodine 15 c.c.; water 485 c.c.); alcohol 25 to 70 per cent; permanganate of potash 1-5000 to 1-50; picric acid 0.1 to 1 per cent; nitrate of silver 1-100,000; carbolic acid 1-100 to 1-40; bichlorid of mercury 1-10,000 to 1-1000; magnesium sulphate, saturated solution; Delbet's anhydrous chlorid of magnesium 12.1 parts water 1000 parts, and others. All of these solutions are useful for different purposes.

On open wounds many of the wet dressings are used to inhibit the growth of bacteria through the antiseptic properties of the solution. Certain wet dressings stimulate the free flow of lymph, and thus mechanically wash away the bacteria. With the exception of the sugar solution, these dressings are usually applied hot, and thus the circulation is improved and the physiological processes are stimulated. When compresses are used on infected wounds, they should be changed every 2 to 3 hours.

I frequently use 25 to 70 per cent alcohol dressings, varying the strength according to conditions, and find it very satisfactory in cleaning up a sluggish wound. Permanganate of potash (1-50) also makes a splendid dressing for deodorizing and stimulating in such cases.

Dressings wet with normal salt solution, or sterile water, are often more effective than those with antiseptic solutions. At one time bichlorid of mercury (1-1000) was the favorite antiseptic solution for wet dressings. Fortunately, the indiscriminate use of this solution in such strength has been abandoned, as it often caused severe burning of the surrounding skin, and in addition, although the antiseptic action was satisfactory, there was little gain made in the process of healing so long as the use of this solution was continued.

I must take this opportunity of speaking of the danger of putting up an extremity in a wet carbolic dressing (even though its strength is very weak, 0.5 to 1 per cent), on account of the danger of gangrene which often follows.

The Continuous Tub.—The continuous tub, first used in the treatment of burns by Passavant in 1857 (A. Rose), is often employed in the treatment of very extensive infected granulating wounds, whatever may be their cause. The patient, supported on proper slings (usually in a portable tub, such as is used for a typhoid bath) is placed in water kept at body temperature, or slightly warmer (made faintly alkaline with sodium bicarbonate). Potassium permanganate (6. to 8. grams to the tub), may be used instead of the soda, in badly infected cases. It is not advisable to keep the patient in the tub too long, half an hour being sufficient for a beginning. Later, the time may be gradually increased, and the patient may stay in for days without ill effects. If the general condition is not satisfactory, the heart should be carefully watched, as occasionally collapse occurs during an immersion. The normal skin should be anointed with lanolin, or some similar substance, to prevent maceration, when long-continued tubing is used.

The tub is of great value in softening the crusts which often form where granulating wounds are treated by the open-air method. After a short time in the tub, the crusts may be sponged off without pain or bleeding. Adherent dressings may also be removed without difficulty after a soaking in a tub. Compresses wet with normal salt or boric solution, or with 1 per cent hydrogen peroxid, may also be used for removing crusts.

Following the proper use of the continuous tub I have seen remarkable improvement in the condition of the wound as well as in the general condition of the patient. In my opinion it is simply a valuable auxiliary to other methods of wound treatment and should be used only in selected cases. The principle of the continuous tub may be utilized in the treatment of injuries of the extremities, by immersing the extremity only.

Paraffin Wax in the Treatment of Granulating Wounds

Paraffin wax for the treatment of burns was first used by Berthe de Sandford. In 1910 some of his secret preparation, *Ambrine*, was brought to the Johns Hopkins Hospital, and I was able to try it out quite thoroughly. The importance of drying the surface on which the melted wax was to be placed was not at that time appreciated. I used the wax on all sorts of wounds, and although the results obtained were not startling, they were very encouraging. The supply of material was soon exhausted, and no more was available.

Carrel, in 1911, while studying the healing of wounds, compounded a flexible paraffin mixture.¹ This dressing I have used instead of ambrine ever since with great satisfaction.

The use of ambrine on war burns has been exploited in the "Press," and has focused the attention of the profession on the value of paraffin dressings in treating burns or large granulating surfaces.

As the formula of ambrine is secret² and its price exorbitant, many paraffin wax mixtures have made their appearance on the market or have been reported in the journals, and several of these are very satisfactory. Numerous excellent papers on the use of paraffin wax have appeared in the last three years.

The requirements of a successful mixture are, that it should be neutral in reaction, flexible, adhesive, and cheap.

Method of Application.—The wound should be dried thoroughly with an electric hot-air drier, an electric fan, or even an ordinary fan will serve the purpose, until there is no moisture on the surface. If blebs are present, they should be punctured, but not excised.

The sterilized melted wax should then be sprayed over the entire surface of the wound, with a margin on the surrounding skin. A double-jacketed (special) atomizer, heated by electricity, or hot water is used for this purpose. If an atomizer is not available, the melted mixture may be gently daubed on with a broad, soft camels-hair brush.

The application is practically without pain, and when the atomizer is used there is no danger of burning, but if the brush is employed, the temperature should not be above 150°F. After the first coat has been applied over the entire surface, a thin sheet of cotton is placed over the wax coating, and this is also saturated with the paraffin, making the entire dressing a single mass. Over this is placed cotton and a bandage. The part should be immobilized, and the dressings changed every 24 hours. The warm, non-adherent, sealed dressing has a remarkable effect on the growth of epithelium, which is very rapid.

The wax mixture may be used plain, or have incorporated in it various substances, such as Beta-naphthol, oil of eucalyptus, acriflavin scarlet red, etc. I have had good results with the Beta-naphthol, as

¹ FORMULA.—Paraffin (52°) 18. grams; paraffin (40°) 6. grams; beeswax 2. grams; castor oil 2. c.c. Mix. Sterilize in the autoclave and apply at body heat.

² Ambrine is now said to be composed of gutta-percha 6 to 10 per cent, and paraffin (55°) 90 to 94 per cent. The mixture with the larger percentage of gutta-percha is more flexible.

It seems to aid in controlling infection. Scarlet red (4 to 8 per cent) incorporated in the wax, undoubtedly aids in stimulating epithelial growth.

The method has many advantages. It is simple to apply, and with proper facilities requires little time. The application usually causes no discomfort, and often relieves pain which may previously have existed. The changes of dressing are painless, as the cotton paraffin shell can be removed without difficulty, and there is no injury to either granulation tissue or growing epithelium.

In wards where this dressing is used, the odor is at times very disagreeable.

Secretions may be removed with irrigations of boric or salt solution or mopped off with cotton pledgets. When there is much necrosis or where infection is severe, the wound must be put in proper condition by the use of the chlorin antiseptics or one of the other methods, before the paraffin wax is applied.

The cicatrix following the healing after the use of the paraffin is smooth and flexible and does not seem to have the same tendency to contract. I have not been favorably impressed with paraffin as an early dressing for small deep, or Ollier-Thiersch, skin grafts, especially if they have been placed on a granulating surface. After the grafts have become firmly established, the paraffin wax mixtures can be used with advantage and rapid epithelial growth will follow, both from the grafts and the wound edges. On a whole-thickness graft, however, which fills a clean defect, they can be used with satisfaction. I have left some of these dressings undisturbed for as long as two weeks.

The Use of Adhesive Plaster

Adhesive plaster is one of the most valuable of our surgical dressing materials. The kind now almost universally used is the so-called zinc oxid plaster, as it is less irritating to the skin than ordinary adhesive plaster. This may be obtained either perforated or unperforated. Before adhesive plaster is applied the part should be shaved.

Adhesive plaster is also used as a dressing immediately next to a granulating wound, either in one piece, or in overlapping strips. When used in this way it provides a closed method and acts very much as do the paraffin mixtures, as it does not stick to the wound and holds in heat and moisture.

Often granulations may be flattened by its use, and when space is

allowed between the strips, or perforations are made, the adhesive is simply a bland non-adherent dressing. If the ends of the plaster are allowed to extend quite a distance beyond the wound margin, or around the part, we then, in addition, have the advantage of support. I have used scarlet red on zinc oxid adhesive plaster with success.

The skin of some individuals is irritated by even zinc oxid plaster and for this reason in applying the plaster, care must be taken not to place it over exactly the same area twice in succession.

Adhesive plaster with its crinoline facing can be wrapped and sterilized in the autoclave with the ordinary dressings. Sterile adhesive plaster may also be purchased in packages.

For ordinary purposes (such as strapping leg ulcers), zinc oxid adhesive plaster can be passed several times through an alcohol flame and be rendered practically sterile. Adhesive plaster is of great use in relieving tension, by supporting surrounding tissues.

The plaster should be removed with as little pain as possible. I find that ordinary gasolin or benzin is most satisfactory for removal as it is efficient, cheap, and easy to obtain. The end of the plaster should be started, and then the gauze pledget, wet with gasolin, should be applied to its under surface as it is raised and to the skin. It will then be found that by continuing this process, the plaster can be taken off with little pain. If the gasolin is put on over the fabric of the plaster, this can easily be removed, but the adhesive material will be left on the skin, and must be subsequently washed off with gasolin.

Ether, oil of wintergreen and kerosene oil will also remove adhesive plaster, but each has its disadvantages. Ether is expensive and the odor is objectional to many patients. Oil of wintergreen is expensive and often unavailable. Kerosene oil leaves the skin greasy and has to be removed before adhesive plaster can again be applied.

The Open Treatment of Wounds

Heliotherapy.—The exposure of infected wounds to sunlight or electric light and air has been advocated by many.

It is advisable that the part be immobilized. In surface wounds the position should be such that secretions may gravitate, and be caught at the most dependent portion (Fig. 119).

The wound should be directly exposed to the sunlight, if possible without the interposition of gauze. It is most important that it be gradually accustomed to the sun's rays, otherwise newly formed

epithelium or recently healed grafts may be blistered and even destroyed. The first exposure should be limited to 15 minutes and the time be gradually increased to 5 or 6 hours. Acute sunburn should be avoided. Wire cages over the wounds and mosquito-netting to prevent contamination by flies, are often advantageous.

Some of the advantages of this method are the relief of pain, painless dressings, bactericidal action of sunlight, a copious oozing and increase of phagocytosis, the rapid casting off of necrotic tissue by healthy granulations, and economy in dressings.



FIG. 119.—Method of using plaster of Paris as a cage over an extensive burn of the leg and lower third of the thigh.—This cage allows exposure to the light and air, and also holds the limb extended in those cases where contracture is feared. Wire netting around the ribs of the cage may be used with advantage.

All sorts of wounds have been treated by this method with success. It is said that the luminous rather than the chemical rays are the most active in their effect on wounds. Whether it is the heat or dryness and consequent bactericidal action, or both, or whether it is the lack of injury to growing tissues which necessarily must take place in the course of ordinary wound dressings, it is hard to say.

My own experience with sunlight has been favorable in certain wounds, but I have seen, at times, extensive burns treated by this method in which the granulations became covered with a thick crust, beneath which pus was confined, and thus the entire benefit of the treatment was lost.

It is of great importance that the surface of these wounds be kept clean, if this method is to be used successfully. In extensive wounds

with accumulation of secretion, it may be necessary to put the patient in a tub for a short time each day to soften the crusts, before exposing the wound to the sun.

Many times sunlight is not available, and in such cases excellent results may be obtained by the exposure of the wound to electric light. This may be done with little trouble, by suspending one or more electric bulbs on a frame which holds the bedclothes from the part. The exposure may then be made as desired, sometimes for many hours at a time. The temperature should not be less than 90° or more than 100°F. A black cloth may be placed over the rack if the continuous light is irksome to the patient's eyes. I have found the use of electric light to be especially satisfactory in drying out edematous granulations; and there is little doubt but that it produces a stimulation of epithelial growth, both from the wound edges, and from any grafts which may be present. Sometimes, when the extreme drying is disagreeable, a spray of sterile liquid albolene is soothing.

Hot Air in the Treatment of Granulating Wounds.—I have had considerable success in the stimulation of healing in sluggish ulcers from the use of baking in an electrically heated hot-air apparatus, in which the temperature could be regulated. The exposures were begun with 10 minutes at a temperature of 150°F., and gradually increased in time to an hour, with temperatures up to 200° or 250°F. The baking process should be continued every day, some bland dressing being applied during the intervals.

In wounds that resist exposure to various forms of hot air and other methods of stimulation, *hot-air douches* given every day will often accelerate healing. The beneficial action is probably due to the stimulating effect of the impact of the air against the wound, the hyperemia induced, and also to the drying of the wound by the air douche. The bacterial count is rapidly diminished, there is relief of pain, the granulations become firm, the secretions become scanty, and the epithelium is stimulated. The healing is rapid and the scar is smooth and flexible.

Many kinds of apparatus have been used for this purpose, from a simple hand pump to the complicated apparatus devised by Küttner. I have had very good results with a simple Foen apparatus, in which the air is forced by an electrically driven fan over a heated coil. With this apparatus the air may be either hot or cold, as seems desirable, but I have usually found the hot douche preferable. Exposure to the current of air induced by an ordinary electric fan is also useful.

The douche should be used each day, beginning with 10 minute

and gradually increasing the time to 45 minutes; the intensity of the heat should be regulated by the feelings of the patient.

Balsam of Peru

Balsam of Peru is most useful as a surgical dressing. It can be poured into fresh wounds, and will differentiate within 24 hours the tissues which will survive. The devitalized tissues will be mummified, and can then be excised. It has been said that balsam of Peru, if used in considerable quantities will have a depressing effect on the function of the kidneys, but after years of experience with it I have not seen this untoward result.

Balsam of Peru is one of the best drugs to stimulate granulation tissue. It has a slight antiseptic action, is an excellent deodorizer, and will soon clear up gangrenous and necrotic surfaces. It is used either undiluted on gauze, or mixed with castor oil, 1 to 3, or 1 to 4. It is also used as an ointment, 10 to 20 per cent in petrolatum.

The Embalmmment Treatment of Septic Wounds (Mencière)

Mencière recommends the following treatment for septic wounds: Wash the wound successively with solutions of bichlorid of mercury 1-1000; carbolic acid 1-40; hydrogen peroxid 1-3. Then dress with gauze saturated with an "embalming" mixture of iodoform, guaiacol and eucalyptol each 10 parts; balsam of Peru 30 parts; ether 100 parts. The wound should be washed for the first three or four days with the three antiseptics, which are used because each one is particularly adapted to a peculiar microbial variety. The usual dressing is then applied. After this only peroxid of hydrogen (1-3 or 1-4) should be used for irrigations on account of the destructive action of bichlorid and carbolic acid on the cells.

The wounds may also be irrigated with the embalming mixture which contains 1000 parts of ether, instead of 100 parts. This method is an excellent one, and I have used it with great success in cleaning and stimulating granulating wounds.

The Use of Ether in the Treatment of Wounds

I have used ether for several years for washing granulating surfaces and have found it very satisfactory as a cleanser. Patients complain

of the coldness due to the evaporation, but the application causes no pain either when it is poured on, or when the wound is mopped with it. I have found that gauze saturated with a mixture of equal parts of ether and castor oil, and covered with rubber protective (which is made adherent to the skin with a few drops of chloroform) causes diminution of pain and also is effective in reducing exuberant granulations in cleansing infected wounds. These dressings can be removed without pain, and should be changed at least once in 24 hours, preferably every 12 hours, as the ether soon evaporates. If desired, camphor or balsam of Peru may be added to the mixture (camphor 1. gram to 100. c.c. balsam of Peru 2. c.c. to 100. c.c.).

Ether is often used in cleansing war wounds and fresh industrial wounds, so that many of these may be successfully closed immediately after being scrubbed with it.

Ether destroys the red corpuscles in the wound and also dissolves the fats and certain alkaloids. It is said that in this way the phagocytes are left unhampered, and that autosterilization of the wound occurs.

Delbet and Richard have used ether as a dressing by applying it several times a day through tubes which penetrate the dressing. The use from 10. to 40. c.c. at each time, and regard the procedure as supplement to dry aseptic technic.

I have found the following to be a satisfactory method of carrying this out: A flat gauze dressing of the desired thickness is applied and over this a considerably larger piece of rubber dam, through which one or two Carrel tubes are inserted, an effort being made to make the junctions air tight. The tubes are arranged so that they lie lengthwise on the gauze below. The edges of the rubber dam are then secured to the skin with adhesive plaster, over which is placed a sort of ring made of gauze, felt, or cotton, which comes to the edge of the gauze dressing beneath the rubber dam, but not over it, and being somewhat thicker, projects above it. Over the whole is placed gauze and a snug bandage. Every 4 hours ether is injected into the tubes, which are then pinched off. In this way evaporation is somewhat delayed.

Glycerin as a Dressing for Infected Wounds

Ruska recently again called attention to the value of glycerin as a dressing for infected wounds. Its hygroscopic action tends to draw edematous granulation tissue, and aids materially in bringing an infected granulating surface into a healthy condition. He uses it c

ompresses, over which is placed an air-tight dressing. The use of undiluted glycerin in my hands has been most satisfactory for reducing dematous granulation tissue and as a dressing for infected wounds. Glycerin itself has a slight antiseptic action, and if more vigorous antiseptic action is desired, iodine, or any other suitable antiseptic substance, can be added to it. The dressings should be changed twice day.

Iodine in the Treatment of Wounds

Long before the value of iodine as a skin disinfectant (as developed by Grossich) was realized, this metal was used either as the tincture or in some other form, in the treatment of wounds. In a 1 to 500 watery solution it is used for irrigations and for saturating gauze dressings. The tincture is used for the disinfection of sinuses, and for swabbing abscesses.

Vaporized iodine has been used for years. The metallic iodine is vaporized by heat, and then blown over the wound surface, where it is deposited and without doubt stimulates sluggish wounds while controlling infection.

Iodoform in gauze, as a powder, and in emulsion and ointments has been freely used. The use of this substance has been abandoned by many on account of its odor, but I wish to state without reservation that on certain wounds iodoform will produce better results than can be secured by any other method of treatment. The antiseptic action of dry iodoform powder itself, has been proved (in the laboratory), to be of little value, but clinically, in contact with the wound secretions, it is without doubt a most valuable therapeutic agent.

The Bipp Treatment of Wounds

(BISMUTH—IODOFORM—PETROLATUM—PASTE)

R. Morison reported the use of a mixture of bismuth subnitrate part, iodoform 2 parts, and liquid petrolatum in sufficient quantity to make a thick paste (this paste is not specially sterilized). After the usual preliminary treatment of thorough opening and excision, the wound is filled with this paste, which is rubbed into the tissues, and then, after the excess has been wiped out, the wound is dressed with sterile gauze or is closed immediately in suitable cases.

Since Morison's early report quite a number of wounds have been treated by the bismuth iodoform paste method, and many surgeons are

enthusiastic as to its efficacy. This mixture can be used in places where facilities for the other more complicated methods are not obtainable. It is undoubtedly of great service both in civil and in war practice, on both fresh and granulating wounds, although it must be admitted that a number of cases of bismuth and iodoform poisoning have been reported following its use.

The Treatment of Wounds with Sugar

Sugar has been used in the treatment of wounds since the earliest times. Galen is said to have used honey on fetid wounds. Recently attention has again been called to its value as a dressing. Magnus found that 89 per cent of the sugar obtained in the open market was sterile and that no germs, except the ordinary saprophytes, were found in any of the samples tested.

The simplest method is to cover the wound with a thick layer of sugar (granulated or pulverized), over which a dry dressing is placed. The dressings should be changed at least once a day. Glucose in a 48 per cent solution, has also been tried, and is useful as a wet dressing, but must be changed every 12 hours, if the best results are to be obtained.

Whitehouse used a glucose solution (strength not stated), which contained carbolic acid (1-80) and reported excellent results.

Probably the chief value of the sugar treatment lies in the fact that a very powerful osmosis is set up, and this floods the wound with secretions until the osmotic tension is equalized.

In addition to its osmotic action, sugar has definite antiseptic and anti-fermentative powers. The dressings are painless and do not stick on account of the profuse discharge.

Sugar (4 to 8 per cent) may also be used in petrolatum ointment with or without 1 per cent iodoform (d'Emidio).

Hercker reported over 1000 war wounds successfully treated with sugar, and says that the profuse oozing from the wound caused by the sugar does away with the necessity of irrigations.

My own experience with sugar as a wound dressing has been confined to its use on ulcers of long duration. There is no doubt that it causes profuse discharge from the wounds, with subsequent stimulation of granulations. The dressings should be changed each day. In war weather sugar should not be used in the Out-Patient Department, for obvious reasons.

The Use of Salt Packs and Sea Water

In order to promote osmosis and to cause a free flow of lymph, salt packs have been used by Hull and others. The salt is placed in bags of suitable sizes made of four layers of gauze, and these are laid on the wound. The dressing is somewhat painful and has little advantage over sugar used for the same purpose.

Abadie finds that concentrated solutions of sea water make a very useful dressing for war wounds, after the necessary excision has been done. He irrigates the wound with a 0.7 per cent solution of sea water, and then packs with gauze, saturated with a 14 to a 28 per cent solution of concentrated sea water. Osmosis is stimulated, and wounds rapidly become healthy.

I have not had an opportunity of using concentrated sea water, but it should be, at least as efficient as salt solution of the same strength.

Normal Serum in the Treatment of Wounds

Lignieres reports remarkable results in the rapidity of healing of wounds treated with compresses dipped in serum, obtained under sterile precautions, which are changed once or twice in 24 hours. If the serum is to be kept for any length of time, or is to be transported, he advises the addition of less than 0.5 per cent of phenol. It was found that serum drawn 24 hours after the first blood-letting, had always greater curative action than the serum first drawn.

E. P. Robinson was very favorably impressed with normal horse serum as a dressing for burns, and believes that its use will eliminate the necessity for skin grafting.

Shortell, Cotting and Leary, in a very comprehensive paper, reported excellent results with normal (beef) serum in the treatment of wounds. The gauze, soaked in serum, should come in contact with every portion of the wound and should be kept moist. On surface wounds the gauze may be changed every 4 hours, or it may be moistened at intervals with the serum and removed twice daily. On burns the latter method was found to be preferable and the dressings needed hanging only once in 24 hours.

Wounds of all kinds were treated. Skin grafts were covered with perforated compress cloth, over which were placed 3 or 4 layers of sterile gauze, soaked in the serum. This was moistened every 4 hours with the serum, and the dressing was first removed on the fourth or fifth day.

The authors found that the serum would control sepsis wherever it came in contact with the infected wound; that it was harmless to normal tissue, and had a prophylactic value in fresh contaminate wounds; that the growth of granulation tissue was markedly stimulated; that when used as a dressing, no matter how large the wound surface, normal (beef) serum did not give rise to anaphylactic symptoms.

This method of wound treatment has its limitations, for general use, both on account of the difficulty in obtaining large quantities of the serum, and also because of the expense. The reported results are most promising.

My own experience, limited to its use as a dressing on several wounds grafted with small deep grafts, proved very satisfactory.

The Use of Soap in the Treatment of Wounds

Before the introduction of iodine nearly every fresh lacerated wound was washed with green soap and water with satisfactory results. Green soap has been used for many years in the cleansing of chronic ulcers by thorough scrubbing of the granulations, but this excellent method has been neglected in many clinics. The scrubbing may be done either with a gauze pledget, or under a general anesthetic with a stiff brush which will also remove the granulations. Recently soap solutions have been used in the treatment of war wounds. Dixon and Bates used a 2 per cent sterile solution of common yellow soap in water, and found that dressings saturated with it did not need to be changed for three or four days, and that the wounds were clean and healthy when the dressings were removed.

Haycraft used a 1 to 40 solution of pure castile soap. Superficial wounds were excised; the soap solution was rubbed into the tissue and the wound was closed. Good results are recorded in all the reports. The dressings are said to be painless; the solution is cheap and easily obtained.

The Two Route Methods of Treating Wounds and Ulcers

To Pfannenstiel is due the credit of introducing the method of precipitating in a wound the iodine from potassium iodide, or sodium iodide, given internally, by bringing the surface of the wound in contact with dressings kept constantly wet with peroxide of hydrogen (3 per cent, acidulated with 1 per cent acetic acid).

The technic is described by von Reuterskiöld, and is somewhat complicated, but the same result can easily be obtained by the continuous low instillation of the peroxid solution with properly placed Carrel's tubes (after adequate protection of the skin with vaselin or lanolin) and after providing for necessary drainage.

Von Reuterskiöld divides the potassium iodid dose into four parts, distributed over the day as follows: First dose $\frac{1}{3}$; second and third doses $\frac{1}{6}$ each, and the last $\frac{1}{3}$ of the whole quantity determined for the particular person.

The usual combination is as follows: 3. grams of potassium iodid per day, in doses as above by mouth. Continuous irrigation of the wound with 3 per cent solution of peroxid of hydrogen, acidulated with 1 per cent acetic acid. Doses proportionately smaller than the one above act more slowly and superficially. After an ulcer or wound has become clean under the full dosage, epithelization and healing progress more rapidly with smaller doses.*

The progress of healing is still further hastened by a skin graft, when the following dosage should be followed: 1. gram of potassium iodid, and 1 per cent peroxid of hydrogen, acidulated with 0.25 per cent acetic acid.

When the patient shows signs of gastric disturbances due to potassium iodid, the same amount of the drug may be given per rectum. Von Reuterskiöld used the method successfully in leg ulcers (acute and chronic), infected wounds and for acute and chronic empyema.

I have had only a limited experience with this method, and am unable to give a definite opinion as to its value. However, it seems rational and, if properly carried out, might simplify the treatment of certain selected cases.

Massage and Passive Motion as Aids in the Treatment of Wounds

In the treatment of almost every granulating wound, healing may be accelerated by systematic massage of the tissues surrounding the ulcer, and passive motion of the part involved. The wound should be treated by any method deemed desirable, and in addition, the massage and passive motion should be used for the purpose of improving circulation and loosening adherent tissues.

Cyriax reports good results following the use of massage and passive motion in the treatment of septic war wounds. He says that each

treatment should take from 10 to 15 minutes, and uses vibration and kneading (petrissage) around the wound. The joints and muscles are mobilized by passive and resisted movements, as well as by active movement. Scar tissue should be stretched if necessary. As an adjunct to other forms of treatment in slow healing wounds and in intractable ulcers, this method should always be borne in mind.

Organic Coloring Matters in the Treatment of Wounds.

Anilin dyes have been used in the treatment of wounds for two purposes: (1) For stimulating epithelial growth; (2) for their antiseptic properties.



FIG. 120.—1. Varicose ulcer of the leg, 15×9 cm. ($6 \times 3\frac{3}{5}$ inches) in a negro. Healed by the use of scarlet red in three months. This patient has been under my observation for ten years since healing, and there has been no recurrence. Note the invasive pigment into the newly healed area from the edges, and in a few isolated patches. 2. Same area taken three years later. Note the greater encroachment of the pigment from the edges, and the increase in the size of the patches. This area eventually became completely pigmented.

For the Stimulating of Epithelium.—Since Schmieden, in 1903, directed attention to the clinical use of **scarlet red** for the stimulation of epithelium much work has been done with this dye. A careful study of the action of the dye on a large number of surface wounds has convinced me that scarlet red is a very valuable epithelial stimulant, and although it will not stimulate epithelial growth in every case, it is v

helpful in the treatment of sluggish wounds, if the right dye is used and properly applied (Fig. 120).

It is used as an ointment (4 to 8 per cent), in vaselin, balsam of Peru, or in any other base in which the double effect is desired.

The most satisfactory method of applying the ointment is as follows: Anoint the skin surrounding the defect up to within 1 cm. ($\frac{2}{5}$ inch) of the wound with zinc oxid ointment, to prevent possible irritation. Apply the scarlet red ointment, spread on old linen, either along the edges or over the entire wound; then cover with the usual gauze dressings and secure with a bandage. The dressing should be changed every 24 or 48 hours, and alternated with some bland ointment, as irritation of the skin may otherwise occur. The brilliant red stain is an objection to its use, as it is difficult to remove.

Amidoazotoluol,¹ one of the components of scarlet red (said to be the stimulating ingredient) is also an excellent epithelial stimulant, and is applied in the same way. It is used as an ointment (3.7 per cent), which is equivalent to the amount of amidoazotoluol in an 8 per cent scarlet red ointment. There is no irritation of the skin and the color is not objectionable.

Dimazon.—(This substance is used in Germany under the name of Pellidol.)

Dimazon has also given very good results as an epithelial stimulant. I have used it (2 per cent ointment or oil) on many wounds in the Out-patient Department, and am favorably impressed with its action. There is no irritation of the skin, and no staining. The technic of application is the same as with scarlet red (Fig. 121).

It has been said that in the use of these epithelial stimulants there is danger of producing malignant growths, by the over stimulation of epithelium. In a wide experience with these dyes, I have never seen this happen, and do not believe that it is more likely to occur than with other dressings, if the dyes are used intelligently.

One must bear in mind that malignant degeneration may occur in chronic ulcers which have never been dressed with an epithelial stimulant. Hence, if such degeneration does occur, in a chronic ulcer which has at some time been dressed with one of the dyes, it is obviously unfair to denounce the dressing as the cause of the degeneration.

All of these substances may be used in powder form in the desired strength, in any of the usual powders (talcum, stearate of zinc, boric acid, etc.) as a base. They may be incorporated in adhesive plaster

¹ Davis, J. S. "Anns. Surg.," May, 1911, 703.

or dissolved in paraffin wax, in all these combinations they have proved their value as epithelial stimulants, but so far as my observations go they do not exert any antiseptic action.

For Antiseptic Use.—C. E. Simon and Wood found that an acid dye, irrespective of its color (in the standard concentration of 1 to 100,000 at least), is devoid of bactericidal properties, whereas a basic dye, likewise irrespective of its color, may possess inhibitory power. Many of these basic dyes in the laboratory showed a selective action for certain bacteria.

Methylene blue has been used for years as an antiseptic in 1 to 2 per cent strength.

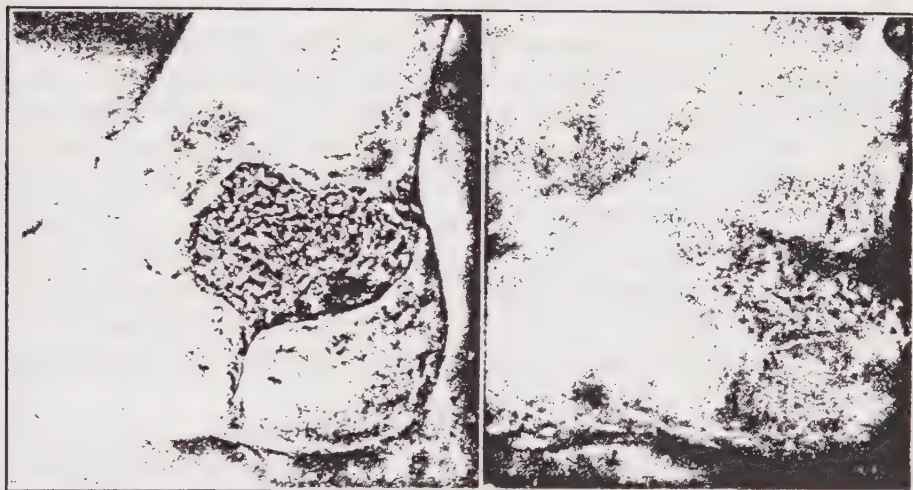


FIG. 121.—Chronic ulcer of the ankle following infection. (F.29803).—Healed in Out-patient department by the ordinary methods. Dimazon ointment, 2 per cent., being the epithelial stimulant used.

Dahlia (Basic fuchsin, and methyl violet), in 2 per cent aqueous solution is very useful in overcoming infection in superficial wounds. I have used it extensively, and have had excellent results. The granulations are dried and the dahlia solution is painted on with a cotton swab. The tissues are stained a deep purple color. On abrasions single application of 2 per cent dahlia is often sufficient. The granulations soon become dry, and the discharge scanty. I often use dahlia on wounds which are to be exposed to the sun or electric light, or on which paraffin wax is placed, and find that the infection is controlled more rapidly, and healing is hastened.

This substance seems to have the double quality of a germicide, a

f an epithelial stimulant. I have also used it with satisfaction in per cent ointment in equal parts of lanolin and vaselin. The action of dahlia is selective for certain bacteria.

Gentian violet in 1-1000 solution has been used by Churchman for rigating infected joints, as it has a definite selective action on certain acteria. I have used gentian violet (2 per cent) in ointment of equal arts of lanolin and vaselin, with success.

Basic Fuchsin.—The germicidal action of basic fuchsin (Grubler's 'uchsin, or Fuchsin Merck Medicinal), was tested by May, and later, 1 conjunction with Heidingsfeld, he reported on its clinical action on ranulating wounds. The dye was used in 1-1000 strength, and the ressings were saturated with it.

Chronic ulcerative processes cleared up promptly, and there was arked stimulation of epithelium from the edges, and also of granula-on tissue. Good results were also obtained with the following oint-ent: Fuchsin 1 part, petrolatum 5 parts, and lanolin to 100 parts.

Acriflavine has been used with success in the treatment of war ounds. The best method is to use 1-1000 strength in normal salt blution for the first dressing, and then 1-5000, and 1-10,000 if the arrel method of intermittent instillation is used. Gauze may also be aturated with it for packs or for compresses. It is non-toxic. It revents suppuration and infection. The surrounding skin is not ritated.

Acriflavine should be used only as an early dressing, as after the rst week little advantage is gained, and the substance seems to delay he process of repair. In the majority of cases the wound is not rered bacteriologically sterile.

Tubby, Livingston and Mackie have used acriflavine in a paste ith the following formula; bismuth carbonate 25 per cent; paraffin 5 per cent; acriflavine 0.5 per cent. All necrotic tissue is removed nd drainage is established. The wound is then washed out with ethylated spirit, or with absolute alcohol, and is packed with the aste. Relief of pain, rapid diminution of infection, and improvement 1 the condition of the wound soon follows.

The antiseptic action of acriflavine has been found more prompt han that of *proflavine*, which is used in the same way, although the atter is effective and is easier and cheaper to make.

Brilliant green has been used with success in the treatment of ar wounds in 1-500, and 1-1000 strengths. Hey has also used this ye as a paste, as follows: Boric acid 11 ounces, French chalk 1 ounce,

liquid paraffin 8 fluidounces, brilliant green 17.5 grains (that is about 1-500).

Bonney and Browning have been using a mixture of brilliant green and crystal violet (Hexamethyl-violet) for the last two and a half years for sterilizing the skin and mucous membranes, and are convinced that it is much superior to iodine for this purpose. The solution used contains 1 per cent of a mixture of equal parts of brilliant green and crystal violet, dissolved in equal parts of water and of rectified spirit (alcohol containing 16 per cent of water). The powder is dissolved in the alcohol, and the water is then added.

Six hours before operation the skin is painted with the mixture and a compress saturated with it is applied, and covered with a water proof material. The compress is removed on the operating table and no further painting is done. The skin is stained an intense violet black, which persists for about two weeks. There is no irritation of skin or mucous membrane. The superficial epithelial layer is permeated with the strong antiseptic, which persists for some time. The color may be removed by washing the surface with Eusol or hypochlorite of soda solution.

I have not yet had an opportunity to try this method of skin sterilization, but the penetrating power of the dye and the permanence of the antiseptic action, seem most promising.

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CHAPTER VIII

INTRACTABLE ULCERS AND VARICOSE VENIS

INTRACTABLE ULCERS

For the most part an ulcer that is referred to the plastic surgeon is one that has been submitted to every ordinary method of treatment without success. In this group may be included, and I will consider in the following order, chronic leg ulcers, ulcers in old extensive scars, chronic ulcers of the groin (probably chancroidal in origin), radium and x-ray burns, burns from electricity and some others.

When for some reason or other the radical treatment of the ulcer is impracticable, it may be necessary to temporize and use methods which will allow the patient to continue his occupation. One or other of the methods already mentioned in the section on the treatment of granulating wounds may be used to bring the ulcer into a healthy condition.

It is essential in the care of chronic ulcers (whatever the etiology) to note certain points in order to follow intelligently the progress made in the treatment. For my clinic I have had printed skeleton history cards which are carefully filled in at the first examination, additional notes being made at subsequent visits.

History Card

Mode of Onset. Duration. Number. Situation. Size in cm. Shape.

Discharge.—Scant; profuse; watery; purulent; fetid.

Edges.—Flat; thickened; eroded; undermined. **Tendency to heal.**

Floor.—Granulation tissue; healthy; sluggish; edematous; exuberant; slough; exposure of bone.

Movable over, or adherent to, underlying tissues. Pain, over entire ulcer; localized.

Surrounding Skin.—Normal; defective circulation; scar; pigmentation; infiltration; loss of sensation; loss of hair; itching.

Condition of Veins. Edema of Part. Thrombo-phlebitis.—Thromboid; post-operative; puerperal. **Number of children.**

Adjacent lymph glands. General Condition. Wassermann Reaction. X-ray report. Histological Examination.

Painful Ulcers

Some of the chronic ulcers are so painful that almost any type of dressing will cause great distress. It is often possible to locate one or two painful points in the ulcer, which in reality are exposed nerve endings. After these points have been found, pure carbolic acid, applied for two minutes on a small toothpick swab to the painful point, without being followed by alcohol, will often cure the pain permanently. Even when the entire ulcer is painful, pure carbolic acid applied in the same manner over the whole area will often prove an efficient palliative. Thorough division of the nerves supplying the area, at points fairly close to the ulcer, will effect permanent relief of the pain.

OPERATIVE TREATMENT

The best method of treatment, and the one which can be applied to all of these ulcers, is complete excision and closure, either by skin shifting (immediately or later), or by plastic operation. The ordinary method of procedure is to carbolize or cauterize the ulcer thoroughly and then to excise with a good margin down to normal tissue, taking care not to open into the granulating surface from below during removal. Any type of skin graft may be used to cover these defects, but my preference is for small deep grafts.

If excision is not practicable radiating incisions, including the margins of the wound may be made to improve the circulation, or in addition the base of the ulcer may be criss-crossed with incisions extending through to normal tissue. An incision completely surrounding the ulcer about 2.5 cm. (1 inch) beyond the margin is often useful. The results of these methods are not so good or so rapid as those following complete excision.

The Treatment of Chronic Ulcers by Nerve Stretching.—Smits reports favorable results following nerve stretching and nerve lacerating by the methods suggested by Chipault, in the treatment of perforating ulcers of the foot, and of certain varicose ulcers, which he also believes to be trophic in origin. Piccoli and Fontana were also successful with this method in treating perforating ulcers of the foot. Veyrassat and Schlesinger resected the sympathetic nerves in the sheath of the femoral

artery in Scarpa's triangle, and also reported good results in perforating ulcer of the foot. The same method has been used in the treatment of ulcers in other parts of the body (Fig. 122).

Nerve stretching or laceration was done only in cases in which the ordinary methods of treatment had failed. In addition to the nerve stretching, the ulcer was excised and the defect closed by plastic operation or skin grafting. Varicose veins were also dealt with by surgical methods.



FIG. 122.—Trophic ulcer of the foot.—An ulcer of this type is difficult to heal. Rest in bed, constitutional and local treatment being the best preliminary steps. Later, when conditions are favorable, nerve stretching with grafting of the granulating surface, excision and the implantation of a pedunculated flap.

In the perforating ulcers of the foot, in various cases the following nerves were either stretched or lacerated: the external saphenous, the posterior tibial, the musculo cutaneous, the plantar, the external popliteal, and the sciatic.

In varicose ulcers the following nerves were either stretched or lacerated: the internal saphenous, the external saphenous, the external popliteal, and the sciatic.

I have had no experience with this method, but it seems rational, especially for trophic ulcers. The radical operative procedures used

conjunction with the nerve stretching may have a good deal to do with the favorable results.

Treatment with X-ray or Radium

I have had no personal experience with the x-ray or radium treatment of chronic ulcers, although good results are reported. Nevertheless, many ulcers have been referred to me after having been submitted to such treatments without benefit, and in some of these the problem has been complicated by burns due to the radiation.

Etiology of Chronic Leg Ulcers

In a large majority of these ulcers it is impossible to decide upon the etiology. Many of them are punched out and have the clinical char-

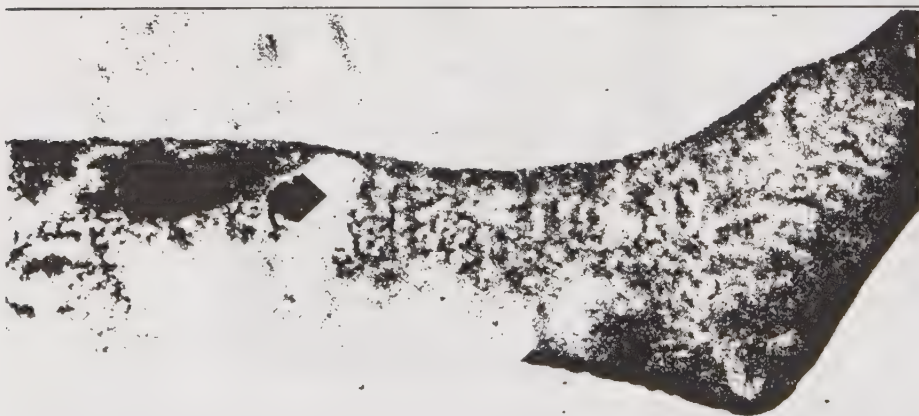


FIG. 123.—Typical varicose ulcer of the leg of long standing.—Note the sluggish appearance of the ulcer itself and the involvement of the surrounding skin with scar tissue. A large varicose vein can be seen between the ulcer and the left hand margin of the photograph. It is useless to attempt a permanent cure in a case of this type unless the veins are excised.

acteristics of luetic ulcers, but no spirochetes can be found, and the Wassermann test is negative; while in others, which are clinically of the varicose type, the Wassermann test is positive and healing is accelerated by the proper systemic treatment.

Again, the veins, which are not visibly or palpably varicosed, are found at operation to be much enlarged, and healing follows the proper operative procedure. In some of this group syphilis is also present,

hence it is often most difficult to determine which condition is primarily accountable for the lesion (Figs. 123 and 124).

The majority of chronic ulcers are situated on the leg, but in spite of their great number and the extreme chronicity of many of them it is remarkable that malignant degeneration is so infrequent.

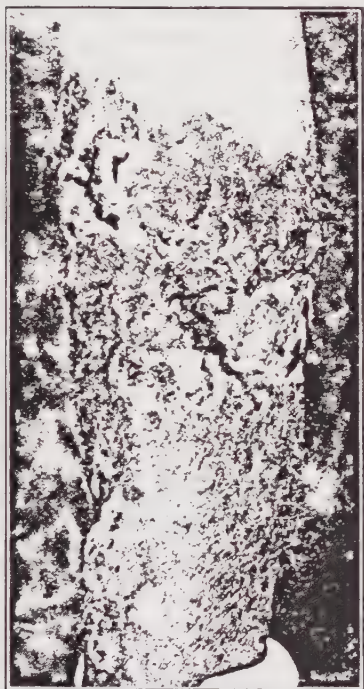


FIG. 124.—Luetic ulcers. Many months duration.—These ulcers were healed by the intravenous use of salvarsan in conjunction with proper local treatment.

NON-OPERATIVE TREATMENT

In the non-operative treatment of an ulcer of the leg, rest and support are of great importance. In many instances the patient cannot afford to lay up, and we have to depend entirely upon *support the part*. This may be obtained: (1) By strapping with adhesive plaster, or bandaging with a rubber bandage. (2) By bandaging with muslin, flannel, or woolen bandages. (3) With a gelatin cast. (4) With a canvas or elastic stocking.

Adhesive Plaster Support.—I once heard the Professor of Surgery in one of the Medical Schools say during the discussion of a paper on the treatment of ulcers, that he had never seen a leg ulcer which he could not cure in six weeks by strapping it with adhesive plaster. Unfortunately, this has not been my own experience nor apparently that of many others, for I constantly see leg ulcers which have been under treatment for many years, and which from time to time have been systematically strapped with adhesive plaster without material benefit. As a matter of fact these old ulcers are extremely difficult to cure, even when submitted to the most radical measures.

I seldom use adhesive plaster for strapping an ulcer for the purpose of support, but often employ it as a dressing. In strapping a leg properly for support, the adhesive plaster should extend from the base of the toes to just below the knee. If the ulcer is discharging, the strapping must be changed at least once in 48 hours. The method is expensive and has little advantage over the bandage. If adhesive is used

rapping, the strips should be about 2.5 cm. (1 inch) wide, and 7.5 or 10 cm. (3 or 4 inches) longer than the circumference of the part. One should start at the root of the toes, as should be done for all supporting bandages, and gradually work up, placing the center of the plaster strip on the part opposite the ulcer and drawing the ends over it.

Martin's Rubber Bandage.—A thin bandage of pure rubber, from .25 to .75 cm. ($2\frac{1}{2}$ to 3 inches) wide, as suggested by Martin, is also used for bandaging such cases, and, after the initial cost, has the advantage of economy, because it can be easily washed. Although it provides good elastic support I do not advise this bandage, as it is difficult to keep the skin in good condition beneath it.

Pressure Bandage.¹—The bandage ordinarily used for pressure is made of muslin. It should be 5 cm. (2 inches) wide for the foot and



FIG. 125.—Method of applying a smooth even pressure bandage to the leg.—After applying the ordinary figure-of-eight bandage to the foot and ankle, follow the contour of the leg upward, keeping both edges of the bandage flat against the leg as described in the text, and as shown in the photographs.

ankle, and from 6.25 to 7.5 cm. ($2\frac{1}{2}$ to 3 inches) for the leg. If wider bandages are used a well fitting support cannot be obtained. Probably no type of bandage is poorly applied so often as a pressure bandage of the leg. For some years I have used with satisfaction the figure-of-eight bandage with long sweeps, fitting it accurately and following

¹ Davis, J. S., "Johns Hopkins Hospital Bull.," April, 1908, 114.

the contour of the leg. It is comfortable, firm, gives an even pressure and, if properly applied, will remain in place.

METHOD OF APPLICATION.—Elevate the leg, sponge the skin with alcohol, dress the ulcer in any way desired, and sprinkle the skin with dusting powder. Cover the area to be bandaged with glazed cotton or a thin layer of gauze, being sure that the entire dressing is smooth. Over this, with a 5 cm. (2 inch) muslin bandage, take a loose turn around the ankle then using an ordinary snugly fitting figure-of-eight pattern, bandage the foot and ankle from the root of the toes. Follow



FIG. 126.—Method of applying a pressure bandage continued.—The same procedure is followed with shorter sweeps as we approach the upper portion of the leg as the pattern gradually develops. There is no reverse necessary anywhere during the application of this type of bandage.

the contour of the leg upward to the level of the tubercle of the tibia, taking care that both edges of the bandage everywhere lie flat against the leg. Then after a circular turn, and using a 6.25 or 7.5 cm. (2, or 3 inch) bandage, come down the leg with a long sweep, always keeping both edges flat, and gradually fill in the uncovered portions. The pattern develops as this procedure is carried on, terminating in one or more circular turns. The end of the bandage is secured with a strip of adhesive plaster (Figs. 125 and 126).

Flannel bandages made of strips of flannel cut on the bias are used where elastic pressure is needed. Several excellent woven bandages

be on the market in which there are no incorporated rubber strips. These have the advantage of being very elastic and are washable.

Bandages can be used in all stages of the treatment, and when the ulcer is foul and the discharge profuse, it is the rational method of support.

The Gelatin Cast (Unna's Paste).—Splendid smooth support can be obtained with the flexible gelatin cast, which was first used by Unna. The process of application is as follows: After a small, flat dressing has been applied to the ulcer, the foot and leg are covered with one or two layers of gauze bandage (preferably by the method described for the pressure bandage). Then this bandage is saturated with a mixture of gelatin 10 parts, zinc oxid 10 parts, glycerin 25 parts, and water 50 parts, which is melted in a double boiler and applied with a brush.¹

A number of similar combinations have been used, all of which are satisfactory. In the application care should be taken that the mixture is not too hot. Another layer of gauze bandage is then applied, over which is painted a second layer of the gelatin paste. This is repeated until 4 or 5 layers have been applied. Then a layer of split glazed cotton (with the glazed side out) is applied over the cast to prevent any sticking to the clothes. Drying of the cast can be much hastened by a buche of cold air.

These casts fit perfectly and, when the ulcer is nearly healed, may be left on for two or three weeks, the skin being kept moist and in good condition. In hot weather, however, they are not so convenient. Until the ulcer is clean, and the discharge is scant, the cast should be changed every day, because, even if a window is cut over the ulcer, the secretions will still run down between the cast and the skin. In selected cases, and during certain stages of treatment, this bandage is an ideal method of support.

The Canvas Legging and Elastic Stocking.—The canvas legging, first described by J. B. Murphy, is an excellent support after healing is complete. Murphy's legging does not include the ankle or foot. After healing is complete and the patient is left to his own resources, I have been using with good results a laced canvas stocking which can be loosened or snugged at will. It includes the foot from the base of the toes (omitting the heel). These stockings are washable and quite durable.

Elastic Stocking.—The woven rubber elastic stocking so commonly used for supporting purposes is very satisfactory as long as the stocking

¹ The original Unna's paste was a mixture of gelatin 4 parts, zinc oxid 4 parts, glycerin 50 parts, water 10 parts.

is new. But as soon as the rubber begins to deteriorate, the stocking becomes loose, the element of support is lost, and the patient who continues to wear it may unconsciously do himself a good deal of harm. The objections to the elastic stocking are threefold: (1) It soon loses its supporting power; (2) It cannot be washed; (3) It is too expensive except for the few.

I advise some of my patients, with much scar tissue on the leg and with occupations in which injury is probable, to use a small footba



FIG. 127.—Bilateral varicose veins of the lower extremities. Duration, many years. The involvement of the right leg in this case was more marked. There was no history of thrombophlebitis. The patient suffered little inconvenience, and came in for another trouble. There had been several superficial ulcers during the preceding years, but they had healed promptly.

shin guard, such as is furnished in athletic stores for boys. Protectors of metal or of felt have been suggested, and some of my patients have made very satisfactory ones for themselves.

VARICOSE VEINS

Many ulcers of the leg are primarily due to varicose veins; others, which have resulted from other lesions, are prevented from healing by the impairment of circulation due to varicosities. Often, after the defective veins have been properly treated the ulcers will heal promptly and there will be no recurrence (Fig. 127).

OPERATIVE TREATMENT

Operative treatment of the veins is essential, if permanent relief is desired.

Four methods will be mentioned:

1. **Excision of portions of the veins**, between ligatures with closure of the skin, as typified by Trendelenburg's operation.



FIG. 128.



FIG. 129.

FIG. 128.—Friedel's operation for varicose veins with extensive scar tissue involvement (Binnie). The long saphenous vein is ligated and divided high up on the thigh. The spiral incision, the loops of which may be quite close or fairly far apart, extends from the ankle to just above the knee and penetrates down to the deep fascia. All bleeding vessels are ligated. Where an ulcer exists the spirals should surround the leg above and below it, and in addition the spirals should be joined by two vertical incisions to isolate the ulcer. The whole length of the wound should be packed and allowed to heal by granulation, care being taken to destroy the superficial granulations so that the epithelium will finally cover the spiral gutter.

FIG. 129.—The appearance of the leg after healing is complete.

2. **Circular or spiral incisions**, encircling the leg down to the deep fascia, with division and ligature of all vessels, without closure of the skin. The edges are kept apart with packing, and deep scars result, which permanently break the continuity of the vessels. This method is typified by the operations of Schede, Friedel, and others (Figs. 128 and 129).



FIG. 130.—Scar following complete excision of the internal saphenous vein for varicose veins.—The scar extends from the saphenous opening to the internal malleolus. The vein is tied on both sides at the opening. The tissues are then turned back as far as necessary on each side of the incision and all diseased veins are removed. In old cases the skin may be friable at the site of healed ulcers, and slight separation of the edges may occur, as in this case. This operation, while it is the most radical, is by far the most effective.

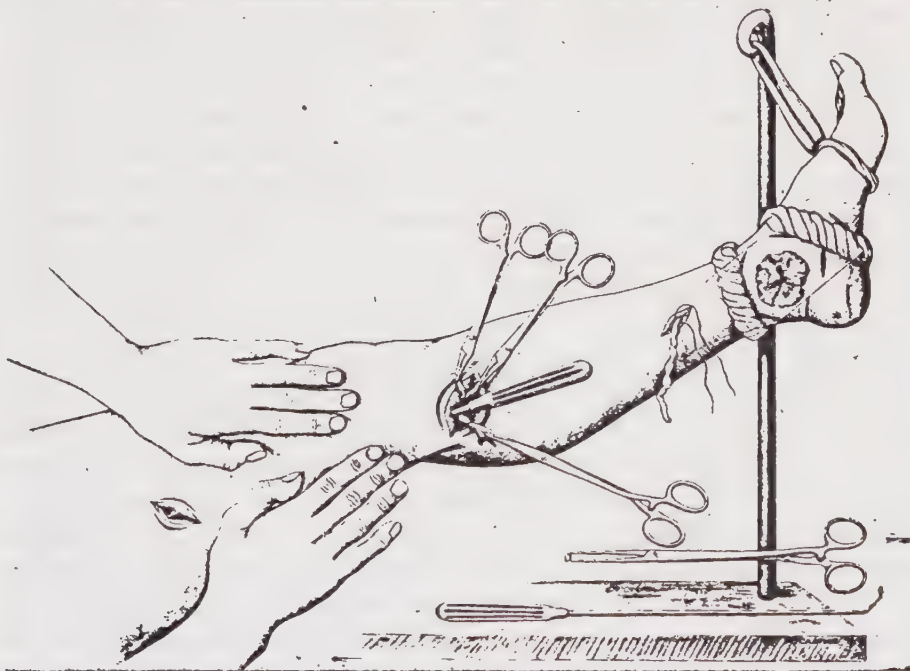


FIG. 131.—C. H. Mayo's vein stripping operation for varicose veins (*Binn*). Expose and isolate the internal saphenous vein near the saphenous opening. Divide between ligatures. Pass the peripheral end of the vein through the loop in Mayo dissector (*a*). Following the vein, push the dissector down to a point near the knee; c through the skin over the loop of the dissector; clamp the vein peripherally, pull it o ligate, and remove the loose portion. If adhesions around the vein prevent the stripping pass the closed lung forceps (*b*) along side of the stripper, and then by opening the blad the adhesions may often be separated. In the same manner continue to remove as ma veins as necessary, always working from above downward in order to avoid detachi thrombi and throwing them into the circulation.

3. **Complete excision of the internal saphenous system of veins**, typified by the operations of Madelung and others (Fig. 130).

4. **The subcutaneous dissection, after division of the vein high between two ligatures**, which is carried out by means of a vein ripper, or a long clamp, as typified by the operation of Mayo (Fig. 131).

The greatest percentage of cures is obtained by complete excision, at this operation is a very extensive one and is seldom done.

A combination of the methods mentioned may often be advised suit a particular case.

The chief danger after operations for varicose veins lies in a resulting thrombosis or embolism. Fortunately, such an accident is relatively rare.

Everything else being equal operative procedures on varicose veins could be deferred until after the ulcer has completely healed. Nevertheless, they are sometimes justifiable before healing is complete, provided only that the ulcer has been sterilized.

It must be insisted that when any operation is done on the veins, the patient should be kept in bed with the leg elevated for at least three weeks. When he is ready to get up a snug bandage or stocking should be applied before the foot is lowered; this should be worn when the patient is up and about for several months, after which it may gradually be discontinued.

Skin Grafts in the Ambulatory Treatment of Ulcers

In the out-patient department of every surgical clinic there is a large, I am almost tempted to say a preponderating, number of persons afflicted with ulcers of varying etiology, many of them of long standing.

When the unsatisfactory results ordinarily obtained in the treatment of these patients is taken into consideration, one cannot fail to appreciate the enormous economic waste to the hospital in time and material. The wage-earning capacity of the patient is nearly always lowered, and in some instances completely lost.

It has always been taught that the first essential for success in skin transplantation is absolute rest, with immobilization of the part affected. I fully agree with this principle as the ideal procedure, and believe that it should always be carried out when feasible. Skin grafts, ordinarily used in hospitals on clean wounds, with the patient in bed and having the maximum of good food, good nursing, cleanliness, fresh air, and above all complete rest, is a simple matter. On the other

hand, let us consider the patients who come to the out-patient department. They are usually poorly nourished, the houses in which they live are often overcrowded, and insanitary. They are, as a rule, unable to stop their work, except for the time spent at the clinic. Many of them should be in the hospital, but there is little chance for even the few who desire such admission to secure beds. In short, rest, the factor of greatest importance in the treatment of these cases, has to be entirely eliminated.

With all these unfavorable conditions in mind, I gradually prepared in the out-patient department of the Johns Hopkins Hospital, a series of cases with the idea of trying my luck with skin grafting. To my surprise the first case grafted (that of a long-standing varicose ulcer) was a complete success, and this success stimulated me to further trial.

In a paper¹ written several years ago I reported the results in the use of skin grafts in the ambulatory treatment of 50 ulcer cases of varying etiology, which might be summarized as follows:

Duration, a few days to 25 years. *Size*, the largest, 8. X 17. cm. ($3\frac{1}{5}$ X $6\frac{4}{5}$ inches); the smallest, 1.5 X 1.5 cm. ($\frac{3}{5}$ X $\frac{3}{5}$ inch).

TREATMENT.—Small deep grafts were used on 48; Ollier-Thiersch grafts on 1; whole-thickness grafts on 1. *Result*, well, 36; improved, 1; unimproved, 5. Of those wounds which were improved by grafting, but not completely healed, 5 were situated on the foot, and 4 on the leg. Of those which were unimproved, 2 were on the leg, 2 on the foot, and 1 on the chest wall. All of the grafts were autografts, and were placed over undisturbed granulations. Small deep grafts were used on most of the wounds, as the operative procedure is simple and furthermore, no other type of graft could have been successful on many of the lesions.

It is obvious that when the grafts are in place they must be secured so that no sliding motion is possible. This is easily done by applying overlapping strips of rubber protective, or a sheet of paraffined mull over the grafts, and then securing this and the overlying gauze dressing with numerous strips of perforated adhesive plaster. Over this is placed more gauze, a snug gauze bandage and, finally, a muslin or crinoline bandage. Sometimes thin strips of splint wood were incorporated in the dressings. During the duration of the treatment every patient in this series had continued his or her daily occupation. In some instances in which the grafts were placed close together, the ulcers were covered with epithelium within a week. When a partial grafting was done, or when only a portion of the grafts were successful, a second

¹ Davis, J. S.: "Jour. Amer. Med. Assn.," Feb. 13, 1915, 559.

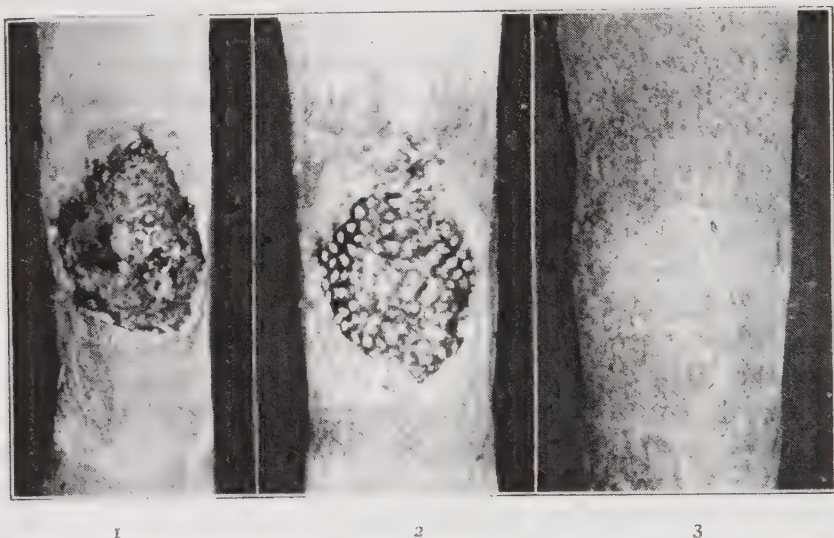


FIG. 132.—Varicose ulcer of leg. Duration twelve years. 1. Before grafting. Ambulatory method. 2. One week after grafting with small deep grafts. 3. Five months after grafting. Examination of the patient five years after grafting showed no tendency to recurrence. The healing was stable and the individual grafts were still plainly visible.

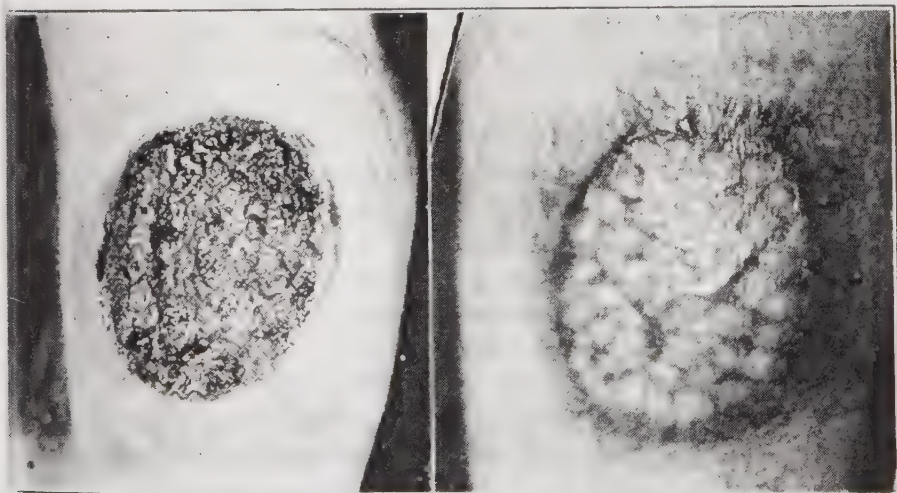


FIG. 133.—Ulcer of the leg following an infection. Duration six weeks. Healed by small deep grafts.—1. Before grafting. 2. Six weeks after grafting. The ambulatory treatment was used in this case and the patient continued his occupation, only returning to the hospital for dressings.

grafting was required to fill the areas not covered. In every case that failed several graftings were done but without result. That several of these wounds were subsequently grafted in the hospital without success would warrant the presumption that our failure was due to the ulcer itself, rather than to the fact that the patient was not kept at rest.

I feel confident that the percentage of takes would have been considerably larger, had situation, etiology and other points been carefully considered in our selection of cases for this series, but in order to test the procedure, ulcers in many situations and of varying etiology were grafted. As might be expected, the ulcers on the feet and legs were more difficult to heal than those in other situations, and the failures were confined almost entirely to those regions.

I have been able to observe some of these patients for four years after grafting, and there has been no recurrence in a single instance.

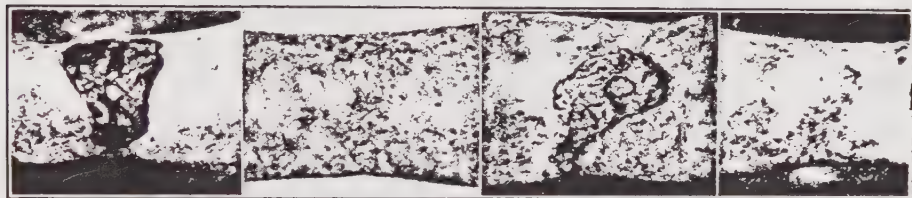


FIG. 134.—Chronic ulcer of the leg due to an acid burn. Duration nine months (F.21878.)—1 and 3. Show the ulcer on the outer and inner sides of the leg joined by a narrow unhealed area. These ulcers were healed with small deep grafts and the patient was allowed to continue his work in a foundry during the treatment. 2 and 4. The same areas six months after grafting.

an area successfully grafted. In one or two patients, with marked varicose veins, small ulcers on other portions of the leg have occurred, but not in the grafted area.

From these and other results in which grafts were used in the ambulatory treatment of ulcers, I feel that we have added to our armamentarium a method of procedure which has hitherto been used only on patients resident in the hospital. In other words, the successful use of grafts in the out-patient department will not only make for hospital economy, but will also hasten the return of many patients to full wage-earning capacity (Figs. 132, 133 and 134).

Ulcers in Old Scars

Not infrequently, especially after extensive burns, we find chronic ulcers situated in the midst of scars which resist all the usual methods

wound treatment. The cause of this resistance to healing is to be looked for in poor circulation, due to dense surrounding and underlying scar tissue. It is in just such ulcers that malignant degeneration occasionally occurs. In these obstinate cases we have to resort to excision down to normal tissue—no matter how extensive the excision may be—followed by grafting of the defect, or shifting in pedunculated flaps (Figs. 135-138).



FIG. 135.—Chronic ulcer in the midst of a dense thickened scar, following a burn, fourteen months.—1. The condition of the ulcer. 2. Three weeks after grafting with small deep grafts. There has been no recurrence during the ten years since grafting. In this case the ulcer might have been excised down to normal tissue and the area grafted, but complete excision of the entire thickened scar was impossible on account of its extent.

Chronic Ulcers in the Groin

Another type of chronic ulcer which has given me much trouble is that which follows a (probably) chancroidal infection. Such ulcers are very difficult to heal and in spite of all our efforts are liable to spread.

Excision with the cautery is the safest, and in the long run the most rapid method of procedure, although it seems so radical that one seldom has the courage to resort to it until every other method has been tried. In some cases I have used the cautery repeatedly to check the spread of such an ulcer, and as soon as the slough had separated and the granulations were healthy applied a few skin grafts and thus gained

a short distance. This procedure was then repeated once or several times until finally the infection was eliminated (Fig. 139).

I have had no help from the x-ray or radium in the treatment of these ulcers.

1



2

FIG. 136.—Ulcer of the ankle following a streptococcus infection. Photograph taken after the excision of the surrounding scar tissue. Duration 6 months. 1. The wound completely healed in two weeks by the use of small deep grafts. 2. Taken two years and three months after grafting. There has been no breakdown after more than five years and the functional result is perfect.

X-ray Burns

X-ray burns were at one time quite common before the methods of protecting patient and operator were known, and when long exposures were necessary to secure satisfactory plates. Today, they are

usually found after treatments for skin diseases, long and frequent exposures in the treatment of inoperable carcinoma, and from the use of the apparatus by unskilled operators. It is generally thought that such burns are rare, but I have seen a great many of them, and have found them difficult to treat. Quite recently I had in the hospital at the same time an x-ray ulcer of the hand; one of the ankle, and one of the sole of the foot.



FIG. 137.—Intractable ulcer of the sole of the foot following frost-bite in a negro aged 8 years. Duration 8 years. (F.1564.)—The only method of treating an ulcer in such a situation with any hope of a permanent functional result is by excision of the ulcer with its surrounding scar tissue, followed by the implantation of a pedunculated flap. The age of this patient contraindicated such treatment.

These ulcers are very chronic, and are usually exquisitely sensitive. This pain may be relieved by division of the nerves supplying the area (A. Eddowes). The surrounding skin is hairless and atrophied, smooth and shiny, with or without a blotchy brownish pigmentation. There are characteristic telangiectases, which may be discrete or occur in reddish patches. Punctate hemorrhages, due to rupture of dilated capillaries, are often present.

The ulcers may be superficial, or may involve the full thickness of

the skin, and a considerable depth of the underlying soft parts. I have seen the entire thickness of the abdominal wall implicated in a burn.

Malignant degeneration often occurs in a chronic *x*-ray burn, and the lives of many of the pioneer operators were lost in this way.

Treatment.—Recent *x*-ray burns should be treated as any ordinary burn. When ulcerations occur which do not heal promptly by the usual methods, excision of the ulcer with a wide margin and down

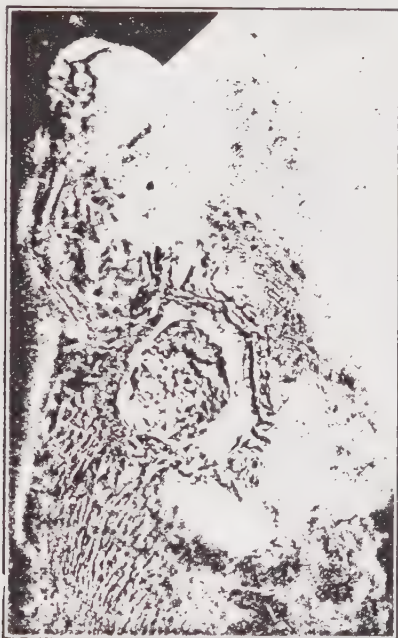


FIG. 138.—Chronic ulcer of the foot following amputation made necessary by trauma. This ulcer is situated immediately over the bone, and the surrounding scar is thin and adherent. The transplantation of a pedunculated flap of skin and fat is the only chance of securing a resistant painless healing.

healthy tissue below, is our only resort. The defect should be grafted immediately, if the base of the wound is of normal tissue, but if a doubtful tissue is left in the defect (owing to the impossibility of complete excision) grafting should be deferred until granulations form. I have used pedunculated flaps in several instances where a soft pad of tissue was necessary.

In excising these areas one is struck by the resistance and rigidity of the tissues which are sufficient to turn the edge of a scalpel. After excising areas 25 cm. (10 inches) in diameter, I have placed the tissue on its edge and found that it would stand erect like a piece of skin.

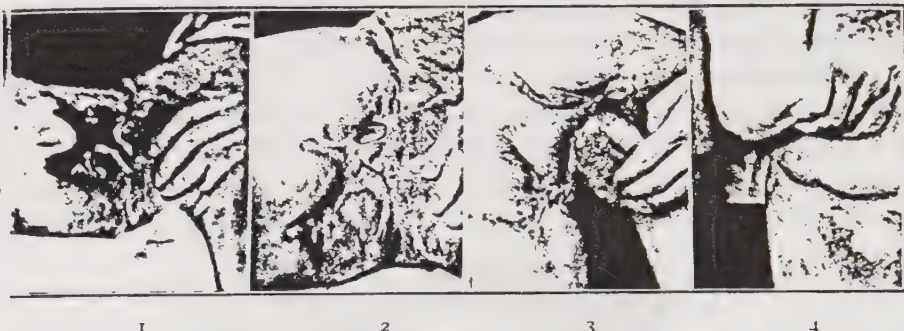


FIG. 139.—Chronic ulcer of the groin following removal of the glands for an infection presumably chancroidal in origin. Duration three years.—1. The tendency of this ulcer is to undermine and spread. Condition when the patient came under my care. Note the irregular shape of the ulcer. 2. Three months later. Note the scar due to the opening of the undermined portions with the cautery, and grafting when the granulations were healthy. At this point the ulcer seemed under control; however, it began to burrow again in several directions and it was a year later before the wound was entirely healed. 3 and 4. Taken one year after 2. Shows the scars in front and behind which indicate the progressive course of the infection. Bacteriological, serological and microscopic tests were of no avail in indicating the cause of this infection. The use of the cautery with grafting of small areas as they became healthy seemed the only method to be depended upon in this case, although many others were tried.

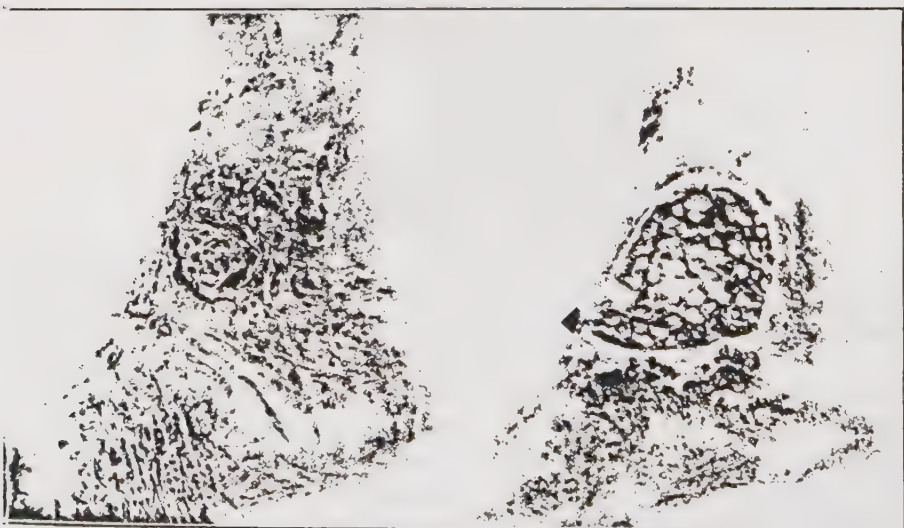


FIG. 140.—X-ray burn of the ankle. Duration two years.—1. Note the position of the burn over the malleolus. 2. The area was excised and immediately grafted with small deep flaps. Complete healing followed and no breakdown has occurred in the two years following the operation.

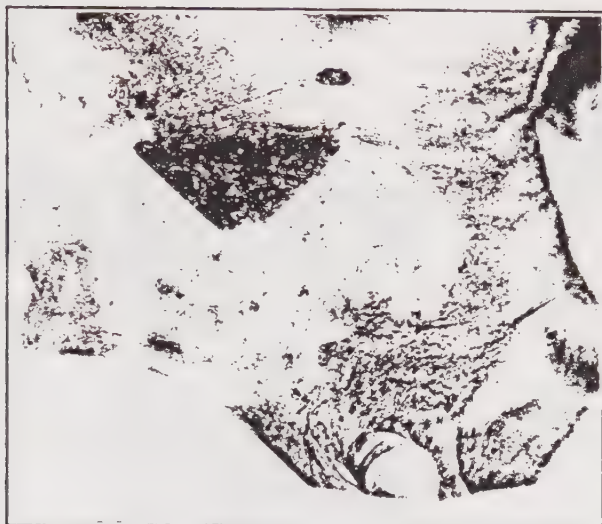


FIG. 141.—Extensive X-ray burn of the abdominal wall.—This burn followed intense X-ray therapy for an inoperable carcinoma of the intestine. The pain was excruciating. The center of the burn was ulcerated and this was surrounded by a rigid brown mass of mummified tissue. The entire area was excised as completely as possible and was immediately grafted with Ollier-Thiersch grafts. Relief of pain and healing followed, although the patient died after several months from carcinomatous metastases. In such cases where it is impossible to excise all of the affected tissue, it is advisable to allow granulations to form before the grafting is done.

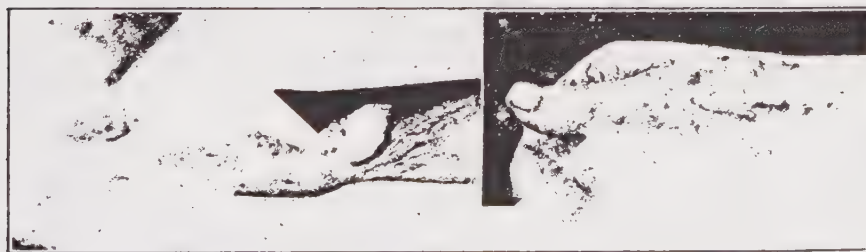


FIG. 142.—X-ray ulcer and burn of the wrist with contracture of the thumb. Duration, ten years.—1. The ulcer on the wrist. The dark line indicates the scar around the ulcer which prevents flexion of the thumb. 2. The ulcer and scar were excised. The surrounding skin was shifted somewhat and the defect left was filled with a whole-thickness graft. Photograph taken two and a half years after grafting. Function of the thumb is perfect and the patient, who is a farmer, has had no further trouble during the ten years which have elapsed since grafting.

ather. Another noticeable feature is the difficulty in checking the hemorrhage, which seems to come from every portion of the wound.

The use of radium has been advised for treatment of x-ray burns. Personally, I have seen quite a few such cases in which after this treatment no improvement was noted, but as a matter of fact the condition was aggravated (Figs. 140-143).



FIG. 143.—Chronic ulceration and keratosis due to constant exposure to X-rays without proper protection.—1. The use of this hand had been practically lost on account of painful ulcerations and the rigidity of the tissues. 2 and 3. The fingers were amputated at the first interphalangeal joints. The ulcerated area on the dorsum of the hand was excised and a pedunculated flap from the abdomen was implanted. The photographs were taken four years after implantation. The flap has gradually assumed the level of the surrounding skin and is soft and movable. The movement of the hand is as normal as may be without the fingers, and is very useful to the patient. Five and a half years have elapsed since the operation, and there has been no tendency to malignant degeneration on this hand. The use of the pedunculated flap on X-ray burns of the hands and feet is the procedure of choice.

Radium Burns

In its clinical appearance a radium burn is very similar to an x-ray burn. The treatment is practically the same, and the same sort of tissue change is encountered. I have seen very extensive destruction due to radium burns, and am sure that these burns would be very much more numerous if the radium was as easily obtained as an x-ray apparatus.

Burns Due to Electricity, Hot-water-bag Burns. Ice-bag Burns

Burns due to electricity may be of the first, second or third degree. They differ from the ordinary burn in that they present at first a dry charred appearance, are not so painful, but are much more intractable.

It is almost impossible at first to determine how much destruction has taken place. A simple looking second degree burn, which would give very little trouble if caused by ordinary heat, may conceal beneath



FIG. 144.—Burn due to electricity. Duration three weeks.—1 and 2. Note the exposed bones and the great destruction of tissue.—3 and 4. After the wound was sterilized with Dakin's solution the exposed bones were removed and the metacarpals were covered, as far as possible, with soft tissue. All other surfaces were covered with small deep grafts. Photograph taken ten days after grafting.

the blister a deep slough. Where the burn has been deep, the slough assumes very much the appearance of a dry gangrene. After the main portion of the slough has come away, further necrosis may occur, and

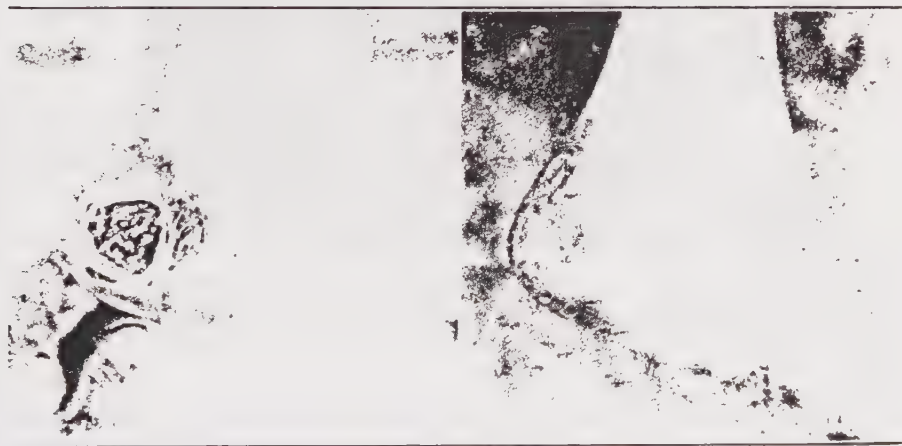


FIG. 145.—Hot water bag burn of the heel. Duration several months.—This ulcer was healed in the Out-patient department by local treatment, and no recurrence has followed during several years.

I have had several cases in which severe hemorrhage occurred either just before or just after removal of the slough. The slough should be removed as soon as its differentiation is complete, and everything should

done to stimulate granulations and the growth of epithelium from edges, as the process of healing is very slow. Time may be saved by excision of the entire area followed by skin grafting, or the shifting of a pedunculated flap. These burns are most frequently seen on the hand, and in many instances there is complete loss of function due to contracture, or to the loss of large portions of the extremity (Fig. 4).

Hot-water-bag Burns.—Burns from hot-water bags which are inadequately covered, usually occur when the bag is placed against the skin of a patient who is unconscious and consequently does not feel



FIG. 146.—Ice bag burn. This burn followed the long continued application of an ice bag on the abdominal wall, which was used for the relief of pain in pelvic inflammatory disease. The destruction extended to the muscle. Note the extent of healing from the edges in three months. The wound was healed promptly with small deep grafts by the tubulature method.

pin. It is as difficult to judge the degree of the burn as in those cases caused by electricity. There is usually intense pain, and the healing is extremely sluggish. After trying many methods, I have found that where the whole thickness of the skin is involved, excision and skin grafting supply the only rational method of treatment. First and second degree burns should be treated by the ordinary methods (Fig. 145).

Ice-bag Burns.—The application of an ice-bag for long periods to unprotected skin may cause lesions which are very similar to hot-

water-bag burns. The same characteristics are present, and the treatment, where the full thickness of the skin is destroyed, consists excision and grafting. First and second degree burns caused by ice-bag should be treated by the usual methods (Fig. 146).

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CHAPTER IX

SCARS AND KELOIDS

SCARS

If he had to deal only with normal tissue the problem of the plastic surgeon would be simplified. As a matter of fact however, the great majority of cases which come under his care are either due to scar tissue or are complicated by its presence. Scars may either interfere with the function of a part, they may be painful, or disfiguring, and any one of these reasons call for the necessary treatment.

Several types of scars are encountered. 1. *The depressed scar*. 2. *The extensive unstable scar*. 3. *The extensive smooth scar*. 4. *The contracted scar*. 5. *The keloid and hypertrophied scar*.

Depressed Scars.—Many excellent methods of dealing with depressed scars have been described by Blair, Esser, and others, and these

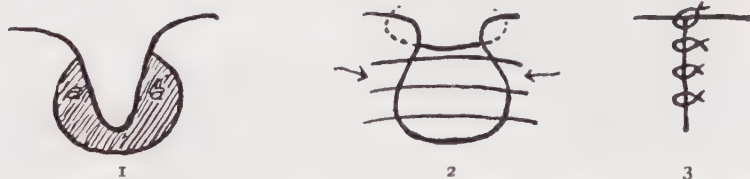


FIG. 147.—Method of repairing a defect due to scar tissue (Blair). 1. The shaded area indicates the tissue excised. 2. Sutures inserted. 3. Sutures tied.

can be best understood by reference to the plates. For several years I have used the method recently described by Poulard for the treatment of depressed adherent scar of the face but the credit of publication belongs to him. I have found it very satisfactory, especially in those situations in which it is difficult to shift in the surrounding tissue any considerable distance. Depressed scars are often adherent to underlying muscles and cause pain and deformity. Complete excision with the transplantation of either a fat or fascia graft and closure of the skin should be considered in these cases (Fig. 147-154).

Unstable Scars.¹—The treatment of tightly stretched unstable scar that frequently breaks down has long been a source of worry to the surgeon and distress to the patient. This type of scar usually follows

¹ Davis, J. S. "Jour. Amer. Med. Assn.," Dec. 22, 1917, lxix, 2085.

extensive deep burns, or loss of tissue by trauma, when the wound has been allowed to heal by the slow process of cicatrization, without the aid of skin grafting or of plastic operation.

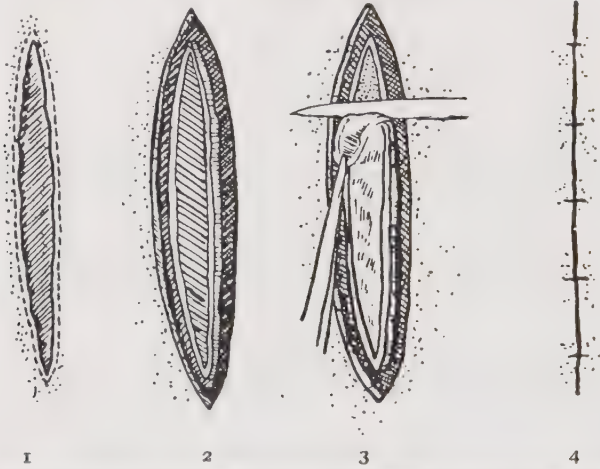


FIG. 148.—Operation for the correction of depressed and adherent scars (*Poulard*).—1. The depressed adherent scar. The dotted line indicates the incision to be made around the scar. 2. The retraction of surrounding skin after the incision is made. The island of scar tissue. 3. The removal of the epithelial surface of the scar. 4. The normal skin closed over the island of scar tissue after undercutting.

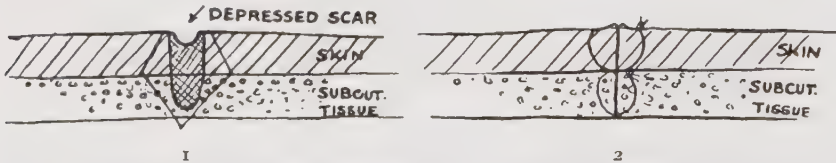


FIG. 149.—Method of excising a depressed scar by means of oblique incisions.—1. The dark lines indicate the incisions made for excising the scar. These incisions make the approximated surfaces somewhat longer than if they were made at right angles to the surface. Thus the line of closure is thicker than the normal skin and allowance is thus made for subsequent shrinkage. 2. The wound closed.

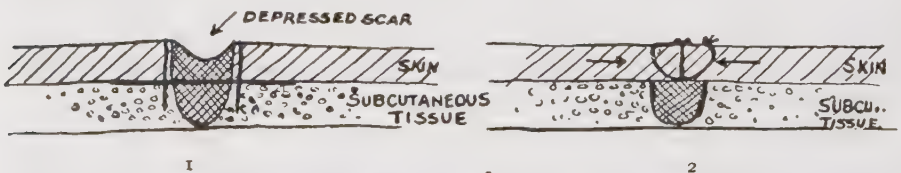


FIG. 150.—Method of using the deep portion of a scar to buttress the skin.—1. The shaded area indicates the scar. The dark lines the incisions. 2. The superficial portion of the scar is excised and the skin undercut, shifted inward and sutured over the undisturbed deeper portion of the scar.

The original wounds are always large and usually involve the entire circumference of a part, such as the leg or thigh, or occasionally

the calvarium. In other words, the scar surrounds and compresses the part.

Some of the scars are bluish red with fine superficial vessels; others are pale and seem to have little or no blood supply. Frequently the



FIG. 151.—Methods of dealing with depressed scars (Aymard).—1. Usual method separating skin from fat, as shown by dotted lines. The fat from each side is then drawn together and held by sutures. 2. Aymard's method. The thick black lines represent incision through the desired amount of fat. The block of fat depends on the skin flap and its blood supply. 3. Shows the fat flap rolled in and sutured. The skin is then closed.

are superficial ulcers of varying size scattered over the surface. These scars are as unstable as wet tissue paper and the slightest injury will start an ulcer that will require weeks to heal.

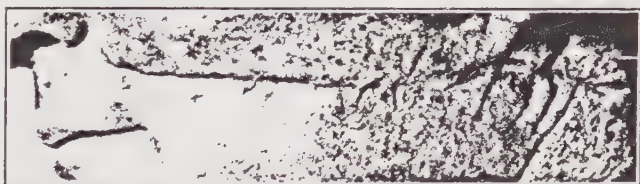


FIG. 152.—Depressed scar of the cheek following a cut.—This scar is directly across the natural folds of the face and neck, and for that reason is especially difficult to correct. It is also deep and the adjacent tissue is infiltrated with scar. Complete excision with use of a pedicled narrow flap of subcutaneous fat turned into the defect is the method of choice, with, of course, very careful adjustment and suturing of the skin.

There is little resistance to trauma or infection and an area that has healed may without any apparent cause, in a very short time break down entirely, or multiple ulcers may develop.



FIG. 153.—Deep adherent scars of the face.—1 and 2. Before operation. 3 and 4. The result of excision, turning over a flap of subcutaneous fat and suturing. The scar on the right side was much more difficult to correct as it cut across the natural folds.

A number of these patients have come under my care, and for a long time they gave me much trouble. After I had used many methods with little success, it occurred to me to try **relaxation incisions** and graft the defects thus made.

TECHNIC.—Preferably the area should be entirely healed before the incisions are made, but in some instances when the healing of the superficial ulcers has been extremely sluggish, I have not waited for complete healing, but have operated as soon as the granulations have been brought into a healthy condition. In preparation for operation in the unhealed cases, after the granulations are healthy, the part is put in a dressing kept wet with normal salt solution for 24 hours. The granulations are then painted with tincture of iodine, and the surrounding scar is cleaned with ether and alcohol.

In many cases the relaxation incisions can be made after infiltration with a local anesthetic such as Schleich's solution, or 0.5 per cent novo-



FIG. 154.—Scars of cheek, eyelids and forehead, following an accident three months previously.—1 and 2. Show the condition on admission to the hospital. The eyelids cannot be closed. 3. Result of excision of scars on the forehead and cheek, and of adjusting the lid margins. Taken one year after operation.

in. In other instances a general anesthetic is advisable, especially if large immediate Ollier-Thiersch grafts are to be used to cover the defect.

On an arm or leg long incisions should be made, parallel with the long axis of the part, down to the deep fascia; or to healthy tissue, if the destruction has been deeper than the fascia. Three relaxation incisions are usually sufficient for a limb, and they result in gaping wounds. The immediate spread of each relaxation incision varies with the tightness of the scar. In some instances it is as much as from

6. to 8. cm. ($2\frac{2}{5}$ to $3\frac{1}{5}$ inches) at the center of the incision. The spread of the first incision is, of course, the widest (Figs. 155-157).

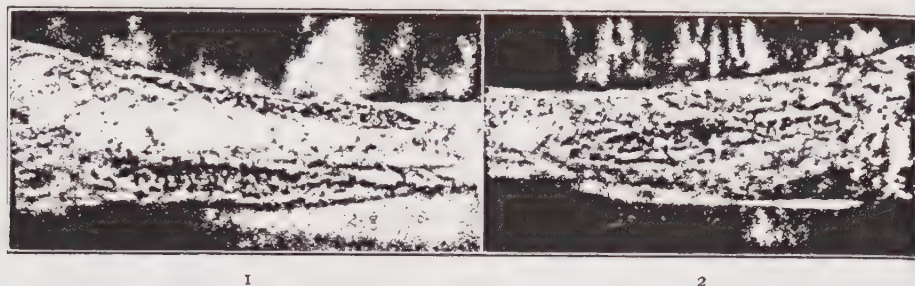


FIG. 155.—Unstable scar following a burn involving the entire circumference of the leg. Duration twenty-five months.—1 and 2. Four days after relaxation incisions were made. The spread of the incisions were 7.5 cm. (3 inches), and 5.625 cm. ($2\frac{1}{4}$ inches), and 4.3 cm. ($1\frac{3}{4}$ inches) at their centers. These wounds were not grafted until five days after operation, as the tissue was unfavorable for immediate grafting.

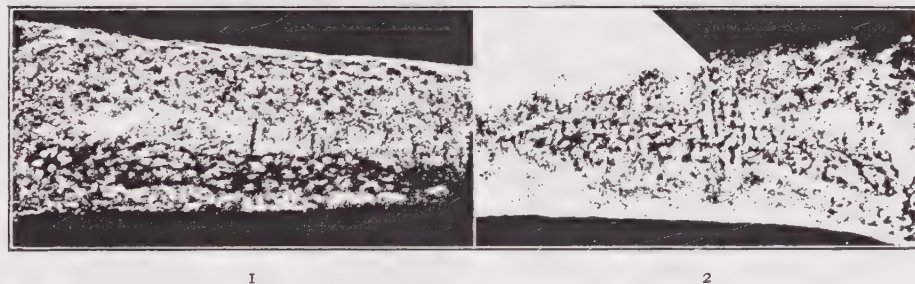


FIG. 156.—Unstable scar of the leg continued.—1 and 2. Two months after grafting. Note the individual grafts and the firm healthy condition of the scar tissue between relaxation incisions. The atrophy of the leg is beginning to disappear.

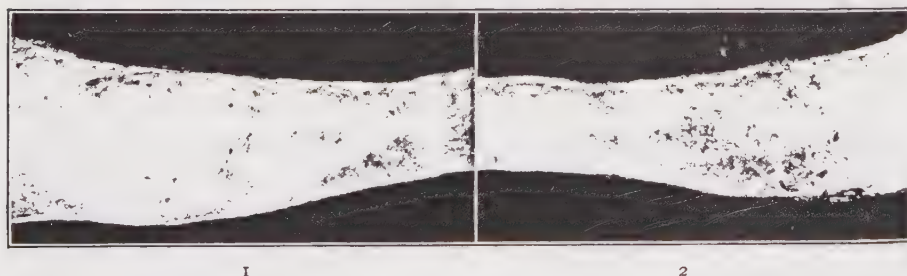


FIG. 157.—Unstable scar of the leg continued.—1 and 2. Taken six months after grafting. The depressions have filled up to the normal skin level. The leg has developed and the patient walks without difficulty, after being confined to bed for twenty-five months.

After the tension has been relieved the appearance of the scar tissue between the incisions soon changes and, instead of the thin, glossy mottled look, the tissue seems to thicken and acquire greater stability. This improvement is much more marked after a few days.

When the scar is stretched over a broad expanse of bone, such as the skull, as many horizontal incisions as may be necessary should be made down to the periosteum. The spread of relaxation incisions over bone is not so marked as over soft parts and some undercutting may have to be done.

In these cases the beneficial effect is more marked after a week or two, but in the end the result is very satisfactory.

In some cases of very long standing the tissue exposed by relaxation incisions has atrophied from pressure and lack of use and has such a poor blood supply that immediate grafting is unwise. In these cases it is advisable to wait for several days until the wounds are lined with granulation tissue, and then apply the grafts. In other instances immediate grafting is justified, but this point must be determined at the time of the operation.

It is extraordinary to note the rapidity of healing of the superficial ulcers after the relaxation incisions have been made.

I have used all types of grafts on the defects caused by the relaxation incisions with satisfaction.

There has been no recurrence of superficial ulceration in any case in which the tension has been completely relieved by the method previously described.

By the use of relaxation incisions with immediate or subsequent skin grafting of the defects, large unstable scars can be strongly healed in a comparatively short time, and patients who have been incapacitated for many months can resume their usual occupation.

Extensive Smooth Scars.—These scars may be level with the skin or slightly depressed, and may cause very little trouble. They may be smooth and movable over the underlying tissues and show little tendency to contract. Unless they are situated on the face or in some other conspicuous position, it is advisable to let them alone (Fig. 158).

Many methods have been suggested. Excision with skin grafting usually gives a result more unsatisfactory than the original scar, unless a successful whole-thickness graft can be transplanted, in which case the result is good.

The method suggested by Morestin of gradual partial excision is by far the best, and I have found the results most satisfactory in a number of cases. In brief, the procedure is as follows: Excise an elliptic-shaped piece of the scar, having the long axis in the direction which is judged most advisable. The size of the ellipse should be limited only by the ability to approximate the edges after excision. The edges should

be sutured (either with or without undercutting), and then after a few weeks, when the surrounding skin has stretched, more of the scar excised in the same way, the selection of the portions to be excised depending on conditions. I often allow several months to elapse between excisions, especially if the scar is on the face. The final



1



2

FIG. 158.—Scar on cheek following a burn. Treatment by gradual partial excision.
 1. The wide depressed scar can be seen. It is unsightly and in a conspicuous position.
 2. On account of the shape, size and situation, complete excision at one time was impossible. An elliptic portion of the scar was removed at the first operation, and the edges were closed without puckering. Six months later, after the surrounding skin had stretched, the remaining portion was excised, and normal skin was sutured to normal skin, the result being a very inconspicuous line scar.

result is a linear scar which eventually can be made quite inconspicuous. This method is unquestionably the best for the purpose.

Contracted Scars.—The most serious result of the formation of scar tissue is to be found in what we may term the contracted scar. There is no doubt that less scar tissue is formed in wounds of any kind and in any situation if the healing is rapid and uncomplicated. The ma-

bject, then, is for the surgeon to assist this process in every way possible.

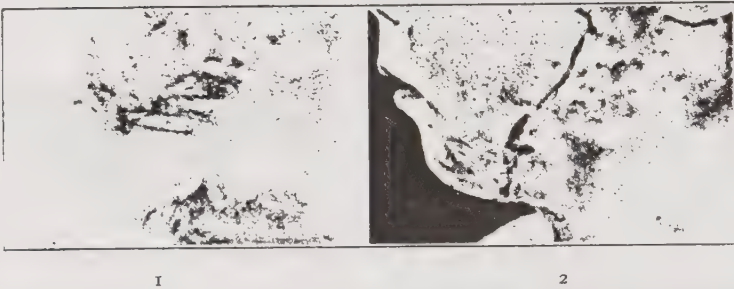


FIG. 159.—Contracture of the chin and neck following a burn.—1. The angle of the mouth is drawn down and outward by the scar which covers the chin and neck. Note the scar on the cheek and the band connecting the chin with the base of the neck on the left side. 2. Result of plastic operation and the shifting of flaps for the relief of the neck contracture and the drawing down of the angles of the mouth. The fresh scar on the cheek the result of gradual partial excision of the scar tissue.

Contracture may take place in any situation and in spite of every effort to prevent its occurrence. The regions in which contractures are particularly liable to occur are around joints and particularly where extremities join the body.

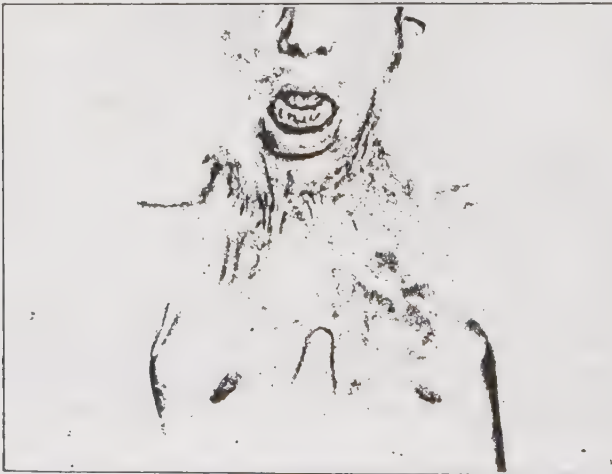


FIG. 160.—Contracture following a burn of the face, neck and chest.—Note the eversion of the lower lip, the tilting outward of the alveolar process and the obliteration of the neck. The ear on the left side is pulled down by scar which involves the cheek and chest. Note the distortion of the areolæ around the nipples by the pull of the scar.

The majority of contractures on the limbs are on the flexor side and very precaution should be taken during the treatment of injuries



FIG. 161.—Bilateral ectropion of both lids due to contracture following a burn. Note the thickened mucosa. The skin of the entire face is involved and there is almost complete destruction of the alar. On account of the scar tissue involvement of the surrounding tissues whole-thickness grafts should be tried first to relieve the ectropion, and if not successful then split pedunculated flaps from a distant part.



FIG. 162.—Contracture of both hands following a burn.—1 and 2. Shows the deformity of the left hand. 3 and 4. Shows the deformity of the right hand.

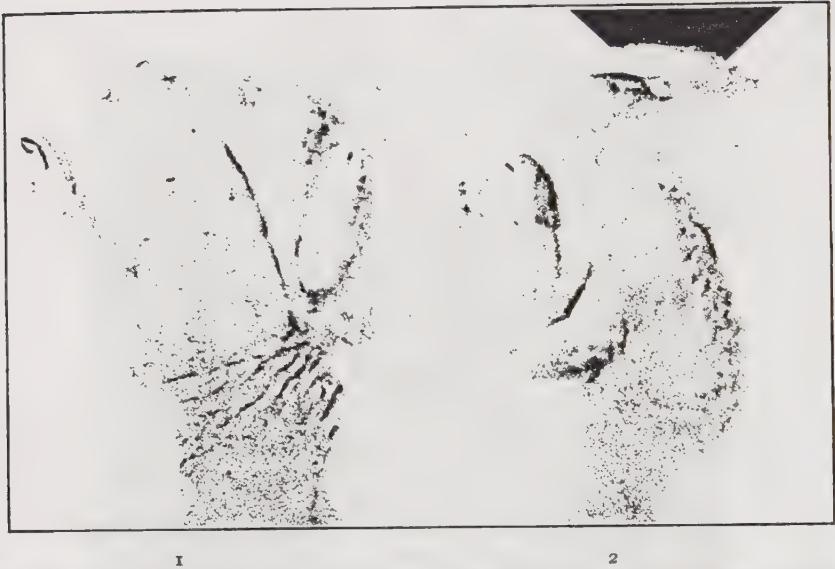


FIG. 163.—Distortion of the hand following a third degree burn in a child.—Note the extreme extension of the little finger and of the first phalanx of the ring finger. Relief may be obtained in such a case, after thoroughly loosening the fingers, either by the transplantation of whole-thickness skin, or by the use of a pedunculated flap from the abdominal or chest wall.



FIG. 164.—Extensive scarring of both legs following a burn. Duration seven years. 1. The anterior aspect of both legs and thighs is covered with scar tissue which frequently cracks down. On the inner side of the left leg a web of scar can be seen extending from the middle of the thigh to the middle of the leg. This prevents full extension of the knee. 2. Posterior view. Note the width of the left popliteal space. The back of the right thigh and leg is covered with a thick irregular mass of scar tissue. 3. Result of removal of the web on the left side, and the formation of a popliteal space by shifting inward a long double pedicled flap of slightly involved skin from the outer portion of the posterior aspect of the thigh. The right popliteal space was improved by excision and grafting, but the result on that side is not satisfactory. This is one of the cases in which extensive involvement with scar precluded the use of pedunculated flaps from the other leg or thigh.

or burns of the extremities, or neck, to avoid this condition by means of over-correction with splints, adhesive plaster, plaster of Paris, continuous traction with weights, or continuous elastic traction, etc. These methods, with proper massage, may also be of use in treating the contractures after they are formed.

Some of the most difficult problems brought to the plastic surgeon are those due to contracted scars. The contractures of any duration exerting a constant tension on bones (for instance of the forearm) will

cause great retardation of the growth of the bone, and I have seen in addition to the retardation marked bowing of both bones of the forearm, and even of the femur, from the constant pull of dense contracted scar tissue (Figs. 159, 164).

TREATMENT.—In the relief of the contractures the entire scar should be excised, if possible, and either the edges closed or the defect filled with a skin graft, or with a pedunculated flap.

I have seen very extensive contracted scars extending from the shoulder to the knee, which prevented an erection. The great size of such a scar absolutely prevented complete excision and this difficulty was overcome as the tension was relieved by breaking the continuity of the scar in several places by excision or division of the

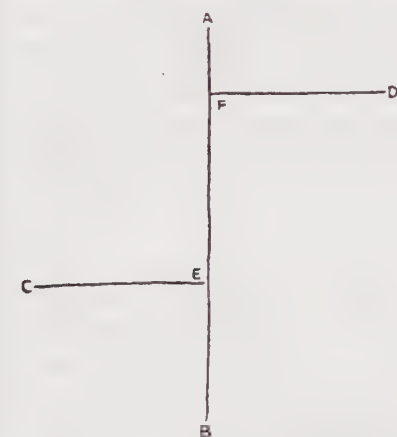


FIG. 165.—Incisions for liberating a band of scar tissue (F. S. Mathews).—The line AB represents the raised band of scar and along it the incision is made dividing it into two leaves. FD and EC represent two lateral incisions. Then by traction the points A and B are separated, and E is drawn into the angle at D, while F is drawn to C. This lengthens the scar and draws the tissues together in an irregular line.

deepest areas and grafting the defects, or shifting in a pedunculated flap.

Division of the contracting bands (with either single or multiple incisions), has often been tried, but in the majority of instances there will be a recurrence in spite of the over-correction (Fig. 165).

The actual treatment of contracted scars will be subsequently considered more in detail under the plastic surgery of the various regions.

Tattooed Skin and Powder Marks

The only way to dispose of *tattooed skin* is to excise the area. For small areas the excision may be done at one time with immediate suturing.

For the large, partial gradual excision with suture each time should be employed. A large area may be completely excised, and after the edges have been drawn in as much as possible, the defect may be grafted. Unless the full thickness of the skin is removed the pigment cannot be entirely eliminated. I have proved this point by transplanting grafts of whole thickness taken from a tattooed area, and have found that the pigment of several colors will remain in the grafted area after it has healed in its new position.

POWDER MARKS in the skin are usually due to an explosion of powder close to the part. If a powder burn is seen when fresh, good results may be obtained by thorough scrubbing of the area with a stiff brush dipped in peroxid of hydrogen. If the particles of powder are well shattered, they may sometimes be removed by inserting a blunted hypodermic needle into each opening, and injecting peroxid of hydrogen which will bubble out the carbon.

In older cases there is little to do except to excise and suture, or to excise and fill the defect with a graft or flap. In the cases in which particles of coal dust have been driven into the skin similar procedures should be followed. When these substances have penetrated through the skin, after the wounds have healed we may have a series of subacute infections occurring sometimes months apart. These should be treated as any other localized infection.

KELOID (CHELOID)

Keloid is a dense, fibrous growth in which the blood vessels and cells are far apart. This condition commences in the corium. Keloids may develop in a clean scar, such as that which follows a *per primam* healing, or spontaneously in the skin. It may also develop when healing has taken place over exuberant granulations in a sluggish wound; in other words it is an hypertrophied scar. The histological picture is practically the same wherever the growth develops (Figs. 166-170).

It is well known that the negro race is particularly liable to develop keloid, even in the most trivial superficial scar. Certain white individuals have this same tendency, but why it exists is not known. I have seen on the same negro extensive multiple keloids of the neck and face, and at the same time smooth, flat movable scars on the arm with no tendency to keloid in them. I have also seen white persons with keloid development in every minor injury of the skin, and in scars following clean operations. I have in mind several instances in which keloid

developed in a portion of a clean appendix scar, while the rest of the scar remained soft, flat, and pliable. It is possible that some su



FIG. 166.—Recurrence after excision of a keloid of the wrist following an acid burn. Note the new growth extending from one extremity of the incision to the other. Also keloid growth at the site of the sutures. This wound healed *per primam* and the growth began after several weeks had elapsed.

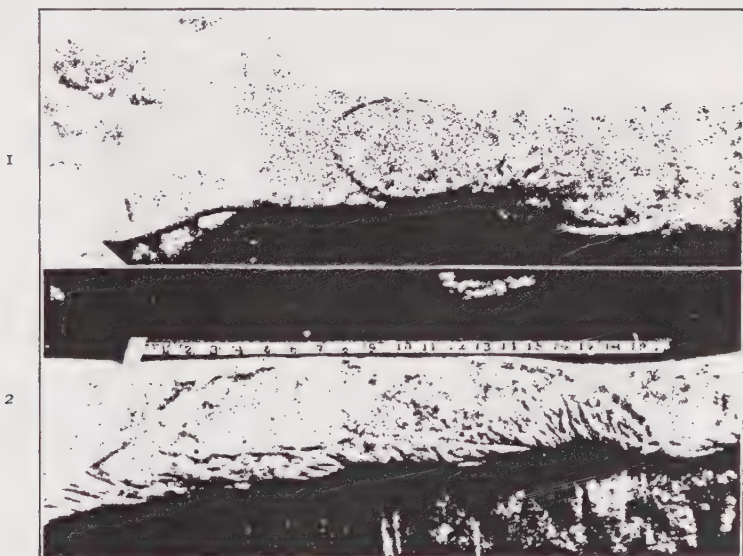


FIG. 167.—The treatment of keloid by excision and whole-thickness grafting.—1. extensive thick keloid of the wrist following a burn was completely excised and the defect covered with a whole-thickness graft. 2. Partial excision of a keloid almost surrounding the forearm. The area covered with a whole-thickness graft extended the length of the growth and from the upper margin to a longitudinal scar which can be seen near the lateral margin of the growth. The ultimate result is considerable improvement in most cases, in some instances the graft also becomes involved with keloid tissue. In such cases the grafted area will gradually become thinner and softer, and eventually be much less objectionable than the keloid itself. Sometimes the graft will be wholly successful and eventually the marginal scar will replace the keloid with normal skin.

stances circulating in the blood, or which is present in the skin, may be responsible for these growths, but this has not yet been determined



FIG. 168.—Keloid following a burn of the shoulder, neck and axilla of a white boy.—A limit of abduction is shown. These keloids were partially excised and whole-knee grafts were implanted. The result was fairly satisfactory as there was complete restoration of function, and the remaining keloid softened considerably. This patient has been under observation for nine years since operation.



FIG. 169.—Extensive keloid on the back and buttock of a negro, following a burn.—A portion of the growth has not yet become pigmented, but the pigment is extending in the edges, and also in isolated patches.

Keloids are hard and usually red and may project above the surface of the skin, in some cases for several centimeters. They are rigid and thus in certain situations (as around joints) may interfere with function. They often itch and burn. Some are very large and may be pedunculated, and these often break down and ulcerate, owing to poor circulation.

Some keloids, if left alone, gradually become smaller, but this is an exception rather than the rule.

The growth may develop in any scar, great or small. I have noticed that it is particularly apt to occur following acid burns. There is no sure way of preventing the occurrence of keloid. The methods of treatment are uncertain, and the likelihood of recurrence is most probable.

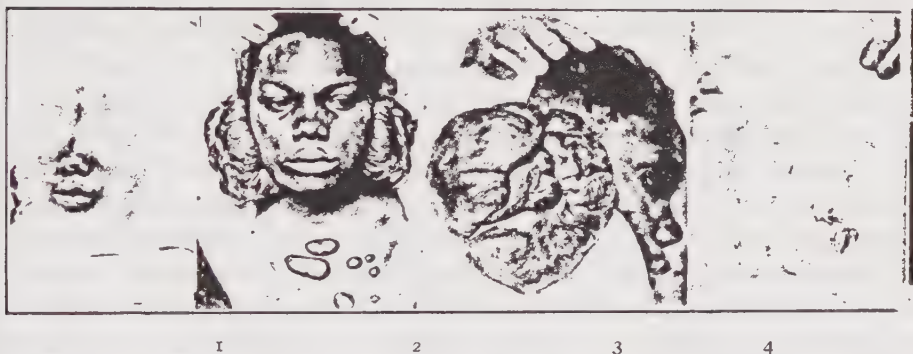


FIG. 170.—Keloid following piercing the ears for ear-rings. Recurrence. (See No. 26285).—1. One year after piercing the ears. Note the size of the growth. The keloid on the other ear was about the size of a marrow-fat pea. The patient came to the hospital because there had been rapid increase in the size of the growth. Complete excision and closure was possible. *Per primam* healing. Recurrence followed, and larger growths were excised a year later with closure, and *per primam* healing. 2, 3 and 4. The patient returned four years after the second operation with the condition shown. The growths on the ear were excised, but not closed, and several radium treatments were immediately given. Two years later the patient returned with an extensive recurrence in all areas where there had been operative interference. (This case was not under my personal care.)

Methods of Treatment.—1. *Excision and closure.* (2) *Excision and skin grafting.* (3) *Partial gradual excision.* (4) *X-ray and radium.* (5) *Injection of fibrolysin, etc.* (6) *Freezing with carbon dioxide snow.*

Excision and Closure.—In comparatively small areas this can be done. If the growth is an hypertrophied scar, there is a possibility of success by this method, but in the majority of cases the growth recurs and is larger than before. Furthermore, keloid may also develop in the stitch holes, and in the needle wounds through which the local anesthetic has been injected.

L. Freeman suggested the underlining of incisions with strips of fascia lata to prevent recurrence of keloids in scars by the elimination of

tension, and reports two cases. He says he does not believe that this method will be of much value, if any, in spontaneous keloid.

Excision and Skin Grafting.—Excision with skin grafting has been tried often, and in extensive cases promises a fair amount of success. It may have had considerable improvement follow the excision of large keloids followed by Ollier-Thiersch grafting, and in some of these cases in which complete excision was possible there has been no recurrence. In a few cases I have used whole-thickness grafts to fill in the entire area after excision and have had fair success. When skin grafts are used, the entire defect should be covered with large grafts.

Partial Gradual Excision.—Morestin has been successful in the treatment of keloid following an extensive burn by partial gradual excision, which is done in a manner quite similar to that already described under scars. I have used this method on a few cases, and am favorably impressed with it.

X-ray and Radium.—A number of articles have appeared on the value of x -ray and radium in the treatment of keloid, and I sincerely hope that by these rays this knotty problem may be eventually solved. However, as a number of these cases are constantly being referred to me by x -ray men, it would seem that they are not quite sure of the success of this method. I do feel, however, that x -ray and radium may be very useful in certain cases, and especially as a subsidiary procedure after excision and closure, or after excision and skin grafting. Curtis Arnham has suggested to me that the radium or x -ray treatment should be carried out first, and that after the scar is flat and soft excision should be done.

Injection Method. Fibrolysin.—At one time the use of fibrolysin (thiosinamin sodium salicylate), was much exploited in the treatment of scar tissue and of keloid in particular. This substance was injected around the keloid, or at a distance from it, every two or three days. The doses are put up in ampules containing 2.3 c.c. of the solution, equivalent to 0.2 grams (3 grains) of thiosinamin, and the keloid is supposed to soften and finally disappear.

Tubby makes multiple incisions, about 0.2 cm. (slightly over $\frac{1}{8}$ inch) apart, across the keloid, and including the subcutaneous fat and so about 1. cm. ($\frac{2}{5}$ inch) of the normal skin on each side. After hemorrhage has been checked he rubs in the fibrolysin and in addition injects from 10 to 20 minims. After the healing is complete the process is repeated. If necessary, this procedure is carried out several times.

My experience with this method has been limited to three or four

cases and in each case the keloid has been larger at the end of the treatment than at the beginning, although possibly a good deal softer.

In my hands fibrolysin has been unsatisfactory, and I prefer some of the other methods of treatment. There seems to be little danger if it is properly used, although I have seen sloughing of the normal skin at the site of the injection.

VARIOUS MIXTURES besides fibrolysin have been used for injection in the treatment of keloid. A mixture of creasote 1 part, to pure olive oil 15 parts, has been advocated by Lesieur, who injects from 0.3 c.c. to 2. c.c. beneath the skin near the edges of the growth, but not into the keloid. This is repeated every two days and good results have been reported, although long continued treatment may be necessary.

Freezing with Carbon Dioxid Snow.—Carbon dioxide, used either as snow which is molded into the desired form, or compressed into an opaque ice by means of a special apparatus, or as a thick mush mixed with ether, is often used in the treatment of keloid. I have had some success with it in the treatment of masses of keloid not larger than 2.5 to 5 cm. (1 to 2 inches) in diameter. The snow or ice should be shaped to conform to the mass of keloid to be treated and the entire surface covered by one piece of snow, or different sections may be treated one after the other, until the whole surface is covered. When snow or ice is used, the element of pressure must be taken into consideration. The treatment should last for from one to two minutes.

When the ether mush is used the surrounding skin should be protected with several layers of adhesive plaster. Then a layer of mush about 0.5 cm. ($\frac{1}{2}$ inch) in thickness is applied with a wooden spatula and is allowed to evaporate. Occasionally after using carbon dioxide snow there is an intense reaction, although generally only blistering over the treated area follows. This area should be dried as soon as possible, and after the scab has come away another treatment is given, the procedure being continued as long as necessary.

The method is uncertain, as are all the others, but occasionally good and permanent results are obtained.

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CHAPTER X

MALFORMATIONS

Quite a number of congenital blemishes and deformities are referred to the plastic surgeon, and it seems advisable to consider them at one time in a general group, rather than to take them up individually in the sections dealing with the various regions (Figs. 171-175).

ANGIOMATA become of interest to the plastic surgeon when the situation is of cosmetic importance, or when their size interferes with



FIG. 171.—Hemangioma of the scalp. Congenital.—This growth projected 2 ($\frac{1}{2}$ inch) above the surrounding skin. The dark areas outlined on the skin are 100 stains following slight nicking which occurred when the hair was shaved. This growth was removed by partial gradual excision. No recurrence has followed.

function. These lesions are usually congenital but they may appear within a few weeks after birth and these either result from abnormal development of preëxisting vessels or are due to newly formed blood and lymph channels.

Many angiomas are found in situations corresponding to the embryonic lines of fusion. Those made up of blood vessels are called **hemangiomas**, and those made up of lymph channels are called **lymphangiomas**.

Hemangiomata may consist either of capillaries, veins, arteries, or large vascular spaces with an endothelial lining. All of these varieties may be found in one tumor. The tumors may be single or multiple. They may be found in any tissue or organ, and on any portion of the surface of the body. They are compressible and immediately

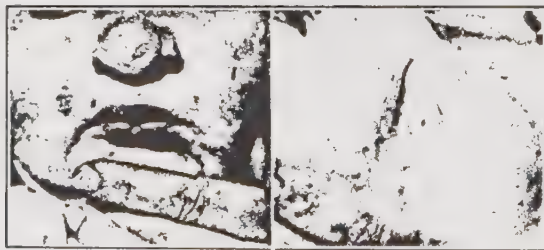


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FIG. 172.—Hemangioma of the upper eyelid.—1. Note the position and extent of the growth. The entire upper lid is involved and the lid cannot be raised to its full extent. 2. The result of several gradual partial excisions. The lid can be raised normally and the growth has been eliminated without distortion or contracture.

fill with blood when the pressure is removed. Some which are composed principally of arteries, or in which arteries open into the large vascular channels, will pulsate. It is seldom, if ever, that a definite single afferent vessel is found, the ligation of which will cause collapse of the tumor.



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FIG. 173.—Hemangioma of the tip of the nose.—1 and 2. Front and profile views. This case was cured by partial gradual excision.

Hemangiomata are quite common. Those which are of particular interest to the plastic surgeon are situated either in the skin, the mucous membrane, or the subcutaneous tissue.

Hemangiomata always present certain potential dangers, the most serious of which is the liability of hypertrophy and possible develop-

ment whereby a small, easily treated tumor, may become a large growth which is difficult to treat, and which may subsequently cause horrible deformity. For this reason alone early treatment should be urged, but in addition we must never forget the danger of hemorrhage which may be spontaneous (in thin-walled tumors), or may occur after slight injury. I have seen several patients who have been almost exsanguinated by such hemorrhage. Moreover, one must always be in mind the possibility of a hemorrhage at the time of operation, which is often severe and very difficult to check.

In the skin the smooth, bright red *nævus flammeus*, or bluish r

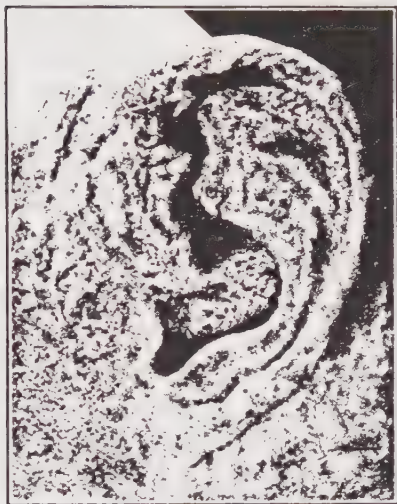


FIG. 174.

Fig. 174.—Angioma involving the upper half of the ear. It is continuous with an extensive angioma of the cheek.—Ten years ago this growth was much more extensive. It was controlled by tying off the anterior and posterior auricular vessels, and by multiple punctures with a fine pointed cautery. Just before this photograph was taken rapid growth occurred with much pain, and several spontaneous hemorrhages. All blood vessels leading into the growth were tied and considerable tissue was excised, only enough being left to suture over the cartilage.



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FIG. 175.

Fig. 175.—Hemangioma of the lower lip. Congenital.—1 and 2. Profile and frontal views. This growth was removed by partial gradual excision.

nævus vinosus, both of which used to be called "port-wine mark" are made up of dilated capillaries. Sometimes the surface may be dotted with red or bluish vascular nodules. The color of some of these growths is very faint at birth, but develops rapidly. In others it is brilliant from the first. Some of the "port-wine marks" may fade as the patient becomes older, but this is the exception. These marks often correspond to the peripheral distribution of a cutaneous nevus (Cushing and others). The size varies from that of a pin-head to large areas; one-half of the face, or the greater part of a limb may be implicated. Some of the flat telangiectases may develop later into brilliant

d, sharply circumscribed masses, which are somewhat lobulated on the surface and which may project several centimeters beyond the level of the skin. The hemangiomas in the subcutaneous tissue usually show through as bluish masses (Fig. 176)

Some hemangiomas acquire their full growth within a few weeks after birth, and never tend to spread; others, after being latent for a long period, may spread rapidly, become cavernous, and grow to large size. For this reason early treatment is essential, as it is impossible to determine whether a given tumor will or will not hypertrophy.

TREATMENT.—The treatment of hemangiomas confined to the skin varies with the type.

Treatment of "Port-wine Marks."—The smooth "port-wine mark" when situated on the face, is very difficult to handle. The result of



FIG. 176.—Port-wine mark involving the face. Congenital.—Note that the angioma involvement does not extend past the midline. The warty-looking areas are protruding masses of angiomatous tissue of a different type.

ray treatment is unsatisfactory. Curtis Burnam tells me that excellent lasting results are obtained by the use of *radium* in the case of children, but that adults do not respond nearly so well.

The Paquelin or electric cautery has been used with success, as far as destroying the brilliant color, in searing the "port-wine marks," but if the burn is deep enough to destroy the capillaries a definite scar

is left. Multiple superficial punctures with a fine-pointed cautery have been tried with partial success. The electric needle has also been used with about the same result. All of these cauterizing methods are painful.

In my hands the best results have followed treatment with *carbolic acid snow*, either compressed or as a mush in ether. Personally, I prefer the mush, for the reason that much larger areas can be treated in a short period of time. The technic of application is the same as that described under the treatment of keloids.

Blisters will form, and here and there a superficial slough may occur. A second treatment is given in from 10 days to two weeks (after the scabs have come away), this procedure being continued as long as necessary. The color of the area can be made much paler by this treatment and in many instances a fairly normal looking skin will be left, although scar tissue is always present.

During the freezing, and also during the process of thawing, there is a good deal of pain which, however, soon yields to continuous cold compresses, and the associated swelling soon subsides. In selected areas where the skin is lax, and the "port-wine mark" is fairly small, excision (either at once or gradually), with closure, is the method of choice.

In areas which have resisted all other methods of treatment, excision and grafting with Ollier-Thiersch, or whole-thickness skin grafting may be advisable.

Treatment of Arterial or Venous Hemangiomata.—In small, simple hemangiomata situated in the skin, which project above the skin level, all of the above methods may be used, but the method of choice is excision and closure, as the scar will be smaller than that caused by the other procedures. Partial progressive excision may also be used in large growths of this type. In very large areas excision followed by skin grafting is advisable.

The injection of coagulating substances, such as boiling water, into these tumors has been tried with more or less success. Shrinkage of the growth is obtained, but in this type of tumor such injections are often followed by serious sloughing.

The x-ray and radium have proved disappointing in the treatment of these tumors and, as far as I have seen is not dependable.

Treatment of Cavernous Hemangiomata.—Cavernous hemangiomata have proved very difficult to handle. G. B. New has obtained splendid results in some of these cases in children by burying radium (radium emanations may also be used in the same way), in the substance

the tumor and allowing it to remain there for the required time. This is a great improvement over the external application of radium, and New reports comparatively little external scar following this method. In a personal communication, he says that the results in other patients are not so satisfactory and that a white scar may result.

The treatment of cavernous hemangiomas with the x-ray seems to have been a failure, from the cosmetic standpoint at least. I have had several patients under my care who had been submitted to multiple exposures to x-ray and whose hemangiomas had undoubtedly been cured, but unfortunately at the same time the entire part involved sloughed away and had to be reconstructed from other tissues.

The infection of boiling water into this group of tumors was first tried by John A. Wyeth of New York, and the method was elaborated later by F. Reder of St. Louis. It is certainly effective so far as destroying the growth is concerned.

In brief, the method is as follows: General anesthesia is necessary. The surrounding skin should be protected with moist cloths to prevent chafing. To guard against possible embolism it is necessary to make peripheral compression while the injection is being made. This can easily be accomplished by using flexible lead tubing, which can be shaped to surround the growth, and should be pressed firmly into the skin during the process of injection.

The hands of the operator should be protected by several pairs of rubber gloves, or gloves of thick washable leather. The water (which should be as nearly at the boiling point as possible), is injected from a glass syringe through a slip needle, which is inserted into the normal skin about 0.5 or 1. cm. ($\frac{1}{5}$ or $\frac{2}{5}$ inch) from the tumor. In small tumors the whole area may be injected at one time; in tumors of large size the injections may be made in only a portion of the tumor, the other portions being treated later.

Hyperdistention almost inevitably produces sloughing, and every effort should be made to avoid it on account of the delayed convalescence and the subsequent scar. When the skin begins to turn a greyish color the injection into that portion should be discontinued.

The water should be injected slowly. In large tumors several incisions may be put in at a sitting. Care should be taken that every portion of the tumor is injected. A good deal of swelling usually occurs immediately after the injection, but may be controlled by the use of cold compresses. The treatments should be two or three weeks apart, and quite a number of injections may be necessary to accomplish a cure.

The final result, unless sloughing has occurred, will show a fairly normal looking skin, although the formation of a visible scar is unavoidable if the tumor has been in the skin itself.

Morestin uses a mixture of equal parts of 90 per cent. alcohol, glycerin and formalin, for injection, and reports good results. He uses from 7. to 12. c.c. at a sitting, being very careful not to inject more than a few drops in one place for fear of a slough.

I have used both of these injection methods, and have had success in a certain number of cases. The coagulating fluids have the advantage of forming scar tissue, and I have employed them for this purpose in very extensive growths whose character contraindicated successful operative interference on account of probable fatal hemorrhage. In these cases, after sufficient scar tissue is formed, operative interference may be undertaken without danger.

I have noted symptoms of embolism in face cases after injection of boiling water, and also of the alcohol, formalin and glycerin mixture, but fortunately these symptoms soon subsided.

It is almost impossible to cure one of these growths and leave normal looking skin if the skin itself is involved. For this reason excision is preferable if it can be done with safety. The growth may be removed at one time, or in stages. It may be necessary to divide arteries and veins (such as the facial, temporal, or external carotid) in dealing with growths on the face, and even then the hemorrhage may be alarming and difficult to check. Excision may be used in conjunction with the injection method in very bad cases.

In cavernous hemangiomas of the nose or cheek, the underlying bones are often hypertrophied. In the operative treatment it may be necessary to chisel off these thickened portions.

In large cavernous hemangiomas of the cheek or nose, on several occasions I have transfixed the growth in various directions with blunt steel pins, used on the same principle as Wyeth's hip-joint pins, and by means of elastic compression have obtained a comparatively bloodless field.

Lymphangiomas.—The tumors are very similar to hemangiomas except that they are composed of lymph vessels; they may also develop on an abnormal growth at any time. The cavernous type is of interest to the plastic surgeon, as macroglossia and macrochelia are due to the presence of lymphangioma and are often difficult to treat. Nussbaum has had good results from radium in lymphangioma of the tongue, and considers this the best treatment. He uses either external

lications, or else incises and buries the radium as in cavernous hemangioma. The x-ray seems useless in the treatment of this type of tumor (Fig. 177).

I have had under my care an extensive cavernous lymphangioma of long duration covered with dense leathery skin, which could only be successfully treated by operative methods. Gradual partial excision with final plastic readjustment was employed.

In the dense thickening of the skin with heavy folds which we sometimes find, operative measures are our only resource.

Hypertrophy of the Tongue (Macroglossia).—Hypertrophy of the tongue is caused by a cavernous lymphangioma involving the submucous connective tissue and sometimes the muscle of the tongue.



FIG. 177.—Lymphangioma (congenital) of the thumb.—The growth surrounded the thumb from the base of the nail to the metacarpophalangeal joint. It was removed by partial gradual excision.

It may implicate the whole tongue or only a portion of it. The tongue may be enlarged at birth, or rapid subsequent increase in size of a previously small growth may develop. The enlargement is sometimes so great that breathing, eating and talking are interfered with, and the relief of this condition calls for radical surgical measures.

Treatment.—If the hypertrophy is localized, this part may be excised and the edges sutured. When the entire tongue is involved, a deep wedge of tissue may be removed from the tip or from some other part selected, and the wound closed. It may be necessary temporarily to block or to tie the lingual arteries in extensive cases, and sometimes tracheotomy is indicated.

When the tongue is simply enlarged so that its edges are being constantly bitten, Butlin's operation of marginal resection as modified by Handley, is useful. The tongue is transfixed far back with a strong

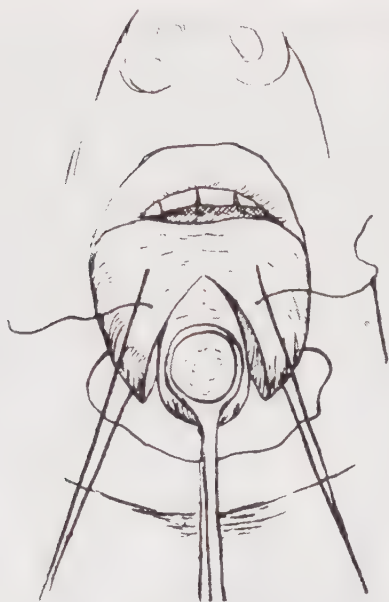


FIG. 178.—Method of excising a wedge of tissue from the tip of the tongue for hypertrophy.—Note the position of the posterior suture which should be tied as soon as the wedge is removed, to check hemorrhage.

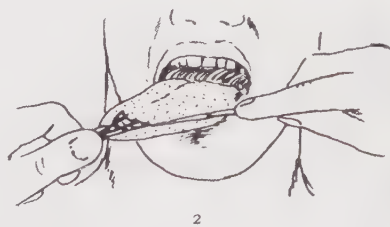
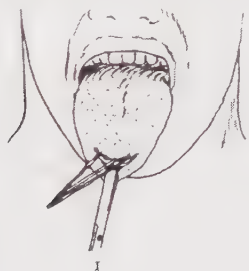


FIG. 179.

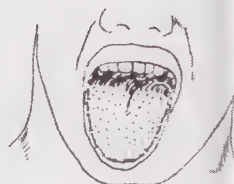
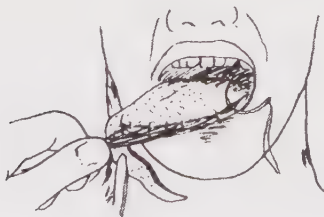


FIG. 180.

FIGS. 179 and 180.—Modification of Butlin's operation for marginal resection of the tongue (*Handley*).—1. Shows the primary incision with sutures placed, which close the wound and prevent bleeding. 2. The tongue is controlled by traction on sutures and a tenaculum forceps. Note the angle of the knife in making the incisions. 3. Shows the shape of the defect after removal of the wedge-shaped area of marginal tissue. 4. The excision has been completed on one side and the sutures placed. 5. The result after completion of operation.

thread by which it can be controlled. The tip is grasped with a maculum forceps and pulled forward. A transverse incision about 1 cm. (1 inch) long is made on the dorsum of the tongue parallel with the tip. The tongue is lifted and a corresponding incision is made below at the junction of the rough mucosa of the surface with the smooth mucosa of the inframarginal portion. These incisions are made so as to cut out a wedge-shaped segment, but the segment is left attached at each end to the tongue. The edges of the wedge-shaped defect are sutured immediately and bleeding is thus controlled. The excision of the wedge is gradually continued, sutures being inserted as the tissue is removed. The wedge is made more and more shallow until the level of the last molar tooth is reached, when the tissue is cut away entirely from the tongue on that side. A similar procedure is then

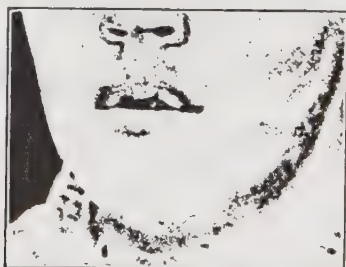


FIG. 181.—Macrocheilia. (Surg. No. 29870).—The mild grade of lymphangioma of the lower lip shown in this case was cured by the excision of wedges of tissue. The tongue was a somewhat thickened but not enough to require operative interference.

carried out on the other side. This is an excellent operation. No blood is lost, the operator has absolute control of the situation at all times, and the necessity for tracheotomy is eliminated. This method may also be used when only one side of the tongue is involved (Figs. 183-180).

Hypertrophy of the Lips (Macrochelia).—Occasionally we find hypertrophy of one or both lips due to a lymphangioma. This may vary in size, in some instances being so extensive that the weight and thickness cause complete eversion of the lower lip. In the more marked cases the motion of the lip is interfered with. The characteristics of these growths are those of ordinary lymphangioma which have been discussed elsewhere (Fig. 181).

Treatment.—Radium is said to give good results. In extensive cases injections of boiling water or other coagulating fluids may be useful, and if the growth is not destroyed by these measures we have

at least the formation of scar tissue, which may facilitate operative procedures.

Excision is the method of choice. This may be done at one time when the involvement is not too extensive, or in stages. The excised areas should be so planned as to avoid puckering and distortion of the lip.

Moles (Extensive).—Extensive moles are usually congenital, appear shortly after birth. They vary in size, but may be very large, sometimes covering a considerable portion of the face, or of a limb. The color varies from a faint brown to a jet black (Fig. 182).

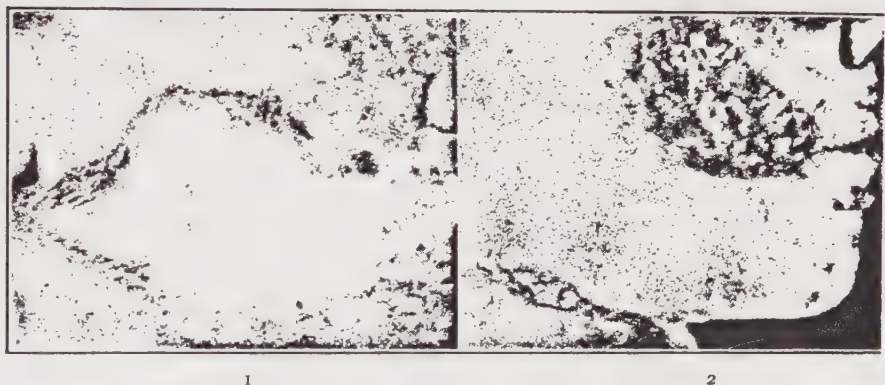


FIG. 182.—Extensive hairy mole of the cheek. Congenital.—1. Note the size of mole. It extends from the angle of the mouth nearly to the lobule of the ear. 2. One month after excision. The skin of the cheek below was shifted up to partially cover defect after a relaxation incision was made, and the raw surfaces were grafted.

Some of these moles, at birth, are depressed slightly below the level of the surrounding skin, and may be soft and velvety to the touch; others are without hair. Others may project definitely beyond the skin level and be thick, pebbly and covered with hair. The growth of hair may be thick or scanty, short or long, fine or coarse.

Treatment.—The best and safest treatment, on account of the possibility of subsequent malignant degeneration, is early excision at one operation, if possible; or if the growth is very large, in stages. I have often excised these growths and filled in the defect with a peduncular flap, or with an Ollier-Thiersch, or whole-thickness graft, and have had good results. Carbon dioxide snow may be used with success on small areas without much hair.

Supernumerary Digits (Polydactylism)

By polydactylism is meant the presence of an excess number of fingers or toes. In many instances heredity can be traced.



FIG. 183.—Supernumerary thumb.—Amputation with proper arthrodesis of the projecting articulation was done.

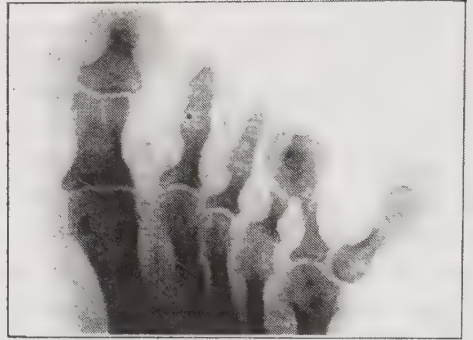


FIG. 184.—Polydactyly. (X-ray No. 35961).—Double little toe.



FIG. 185.—Polydactyly. (X-ray No. 22252).—Five fingers and a thumb, all of which functionate normally.

The deformity may be unilateral or bilateral, or the hand and foot on the same side may be involved. As many as 13 fingers on each hand and 12 toes on each foot have been reported. The fifth finger is most often double.



FIG. 186.—Thickened thumb with double fused terminal phalanx (X-ray No. 46359).

The covering of the extra digits may be composed only of skin and subcutaneous tissue, or all the normal soft parts may be present. The extra finger may approach normal development and voluntary function.



FIG. 187.—Cloven hand (X-ray No. 3377).—The thumb and little finger are present although deficient in phalanges. Note the stumps of the metacarpal bones between. Much can be done to improve the usefulness of a hand of this type by plastic operation.

may be possible. It may articulate with the fifth metacarpal bone or the extra finger may be attached only by a pedicle of skin. (In the thumb there may be all the varieties mentioned above, and,



FIG. 188.



FIG. 189.

FIG. 188.—Hypertrophy of the toes, associated with a fibrolipoma of the sole of the foot. The best treatment in a case of this kind is the removal of the lipoma and amputation or shortening of the toes, depending on conditions.

FIG. 189.—Congenital deformity of the toes.—The second and third toes are missing, the space being occupied by a large fibrolipoma which extends half way down the sole of the foot, and also between the metatarsal bones to the dorsum. Excision is the method of choice in cases of this type.

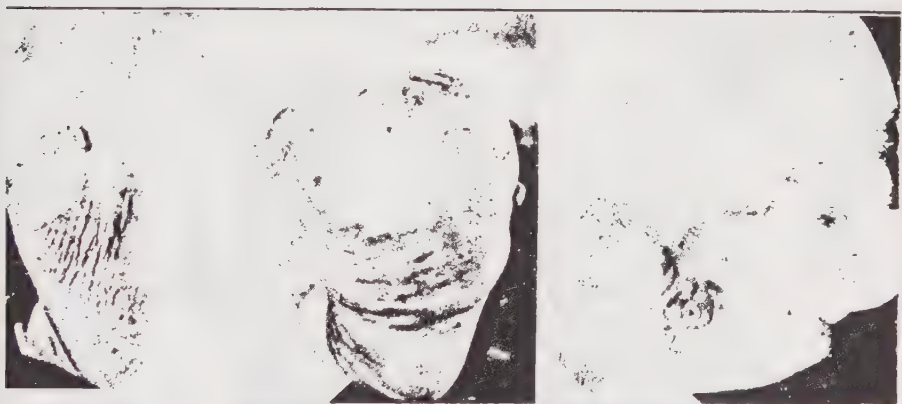


FIG. 190.—Gigantism of the toe.—Note the size of the hypertrophied toe in comparison with the great toe. Amputation is the method of choice in this case, as the phalangeal bones are also much hypertrophied.

addition, the metacarpal bone may be divided and much distorted (Figs. 183-187).

Treatment.—The removal of the supernumerary digits which are attached only by skin, should be by an elliptic incision. The correction of the more marked deformities should be most carefully done and with the aid of the x-ray a useful finger in the proper line may be produced, although several operations may be necessary to accomplish this. The work is ordinarily done by the orthopedist, but occasionally the plastic surgeon is called upon in special cases.

SUPERNUMERARY TOES are less common than fingers. The extra toe is usually found connected with the first or fifth toe, and as a rule



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FIG. 191.—Congenital malformation of the foot.—1 and 2. Compare the two feet. There is marked enlargement of the anterior half of the foot with enormous increase in size of the great toe, and the two adjacent toes, which are fused. The bones of these toes are also enlarged. Note the two normal sized toes. The hypertrophy is due to a fibrolipoma. The treatment was amputation of the hypertrophied toes and partial gradual excision of the other portions of the tumor.

the phalanges only are duplicated. The surgical treatment is principally for the purpose of making it possible to wear an ordinary shoe.

Macroductylia.—Quite frequently cases of gigantic development of one or more fingers or toes, or portions of the hands or feet, are found. They are usually congenital and may be due to obstruction of lymphatic channels, or to the presence of fibrolipomata.

Treatment.—In some instances it is possible by multiple excisions and plastic procedures to reduce the size of the hypertrophied parts. On several occasions I have removed large masses of tissue in order to reduce the size of the foot so that a shoe could be worn. Frequently amputation of the fingers or toes is indicated. There is no definite rule

follow in these cases, except to give the patient an extremity which will be as useful as possible, and which at the same time will not be too conspicuous (Figs. 188-191).

Syndactylism (Webbed Fingers or Toes)

This type of deformity varies greatly in degree. The normal web may be simply increased downward for a greater distance than normal, or it may extend to the ends of the fingers. The web may consist of skin only, and may be loose enough to allow the fingers to be separated to a considerable extent. In many cases, however, it is thick, consisting



FIG. 192.—Unilateral syndactylism.—The nails are not fused and there is no bony union. The groove between the fingers is fairly well marked down to the first interphalangeal joint. There is no family history in this case. Operation refused.

skin and underlying soft parts, and extends to the ends of the fingers, there being only a groove on each side to indicate the line of separation. In some the fingers are closely fused, the nails being joined, and in extreme cases the phalangeal bones also. The terminal phalangeal bones are those most frequently fused.

Syndactylism is likely to be hereditary. A case has recently come under my care with the following history: The patient's maternal great grandmother had fusion of the ring and middle fingers of both hands. The maternal grandfather, who was the seventh of eight children, had the same fingers of one hand involved. The mother, who is the third

of five children, had fusion of the same fingers on one hand. The patient, who is the first of two children, has the middle and ring finger of both hands completely fused. All the other members of the families had normal hands (Figs. 192 and 193).

Two fingers may be fused on only one hand, or all the fingers both hands may be involved. It is a great mistake to operate this condition on a young child. It is much better to wait until sixth or seventh year, but the operation should not be delayed much later than this, especially in severe cases, inasmuch as retarded development may occur if the fingers are not separated.

It is inadvisable to operate on the toes for this deformity.

The successful treatment of syndactylism, however small the degree of the deformity, is difficult. The key to the operative success is



FIG. 193.—Congenital absence of the ring and little fingers. Syndactylia of the index and middle fingers.—The fused fingers may be separated by one of the operations described in the text.

formation of a new commissure which is somewhat higher than normal and healing with the minimum amount of scar tissue.

In separating closely fused fingers, gangrene of one or both fingers has occurred on account of interference with the blood supply, which may not be normal in arrangement. This possibility should be mentioned when giving a prognosis to the family.

Operative Treatment.—In the loose thin web the skin may be divided and the edges approximated without tension, but even in these cases it is difficult to prevent partial recurrence, unless the formation of the commissure is assured. The old method was to produce a fistula by perforating the base of the web and inserting a glass or rubber tube or a piece of heavy silver wire, which was held in place until the healing was complete all around the opening, after which the web was divided.

and the edges were closed. This is an unsatisfactory method and has been for the most part abandoned.

Tubby, however, still believes that a permanent fistula should be formed first, and that later the rest of the fused portions should be separated by the appropriate operation. In order to make this epithe-

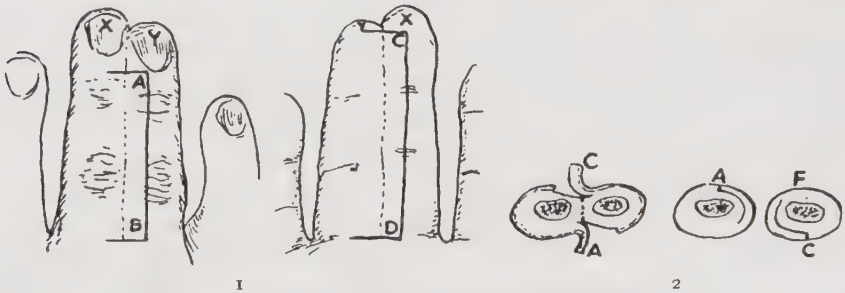


FIG. 194.—Didot's operation for syndactylysm (*Burghard*).—1. The fused fingers X and Y. The anterior and posterior flaps marked by the lines AB and CD, are raised. 2. Transverse section showing method of raising the flaps separating the fingers and closing the defect.

um lined fistula, he raises two triangular flaps of skin and subcutaneous tissue at the situation of the interdigital cleft. The palmar flap is cut in the reverse direction. The dorsal flap is cut higher on the hand because of the slope of the natural web from below backward and upward. These flaps should be as large as possible. The soft tissues

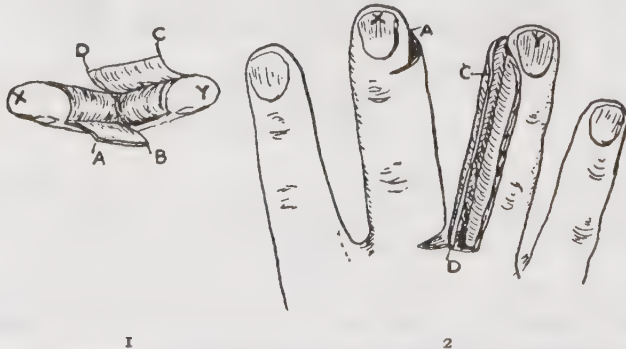


FIG. 195.—Didot's operation, *continued* (*Burghard*).—The flaps raised and the fingers separated exactly in the midline.

which remain after raising the flaps are excised completely. Then the flaps are drawn through this opening and sutured, so as to line it as completely as possible. A glass rod of the size desired is then inserted, and is held in position by a special apparatus, the dressings being applied with anterior and posterior splints. In due time the fistula will be

found lined with epithelium, after which the rest of the web may be separated by Didot's or Nélaton's method (Figs. 194-196).

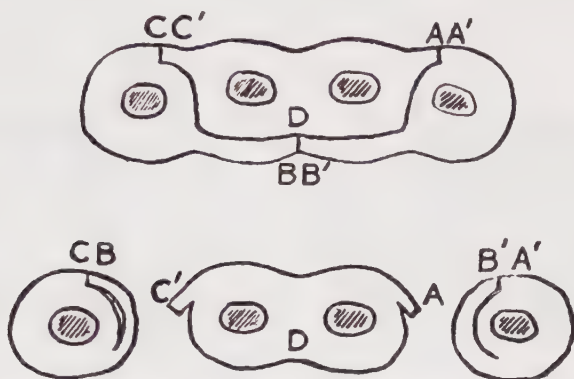


FIG. 196.—Method of covering the index and little finger with skin in syndactyly involving all the fingers (*J. S. Stone*).—The ring and little fingers may be completely covered by the flaps CDB and A'DB'. The denuded surface left after removal of the web may be grafted, or may be covered with a pedunculated flap from the abdomen.

Didot's or Nélaton's Operation.—In this operation a flap is raised from the midline of the dorsum of one finger, and from the midline of the palmar surface of the other. The flaps should extend from the extremity of the web back to the location of the normal web.

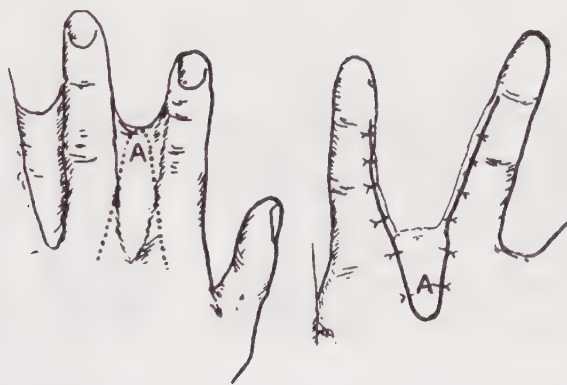


FIG. 197.—Operation for syndactyly (*Agnew*).—1. The dotted line indicates the flap, which is much more blunt than in the original operation. 2. The web divided and the flap sutured into the palm. The lateral skin edges are also sutured. This is only possible when the web is comparatively lax and thin.

After the flap has been raised the tissues uniting the fingers should be divided exactly in the midline to avoid interference with the circulation. When the bones are fused they should be separated with a thin-bladed

is, and the sharp edges rounded off. Then the skin flaps should be brought around to cover the raw surface of the finger to which it is attached, and should be sutured with interrupted horsehair sutures.

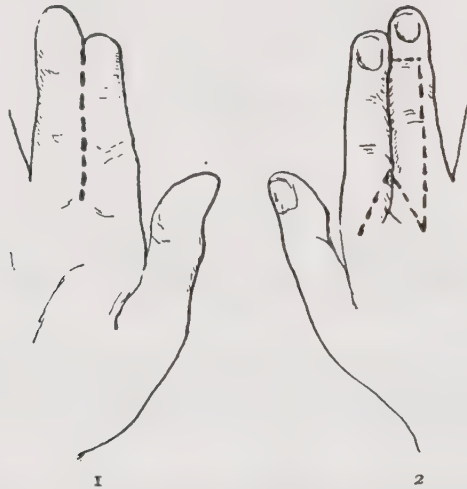


FIG. 198.—Operation for syndactylism (*Bidwell*).—The dotted lines indicate the position of the incisions. The apex of the triangular flap shown on the dorsal surface is sutured to the palm. The skin flap from the dorsum of the middle finger is sutured to the palmar surface of the middle finger, and will cover it. This leaves normal skin on the palmar surface of the middle finger. Uncovered areas may be skin grafted, or may be covered by pedunculated flaps. This operation is an excellent one and with some modifications I have used it with satisfactory results.

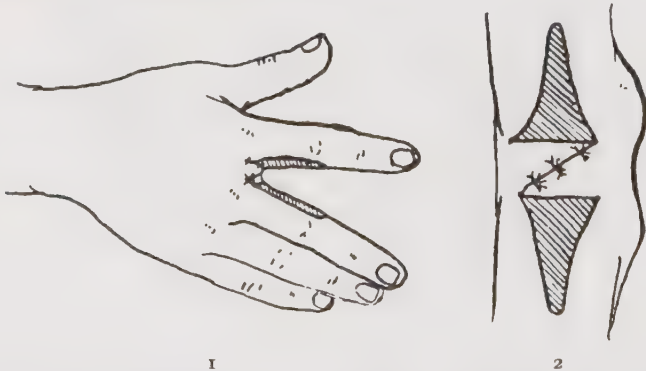


FIG. 199.—Method of forming the commissure in syndactylism (*Félizet*).—1. The flaps are secured from the palmar and dorsal surfaces of the web and are overlapped and sutured edge to edge. By this method a broad thick commissure may be formed. The type of the flaps must necessarily vary according to the type of web. I have used this method in conjunction with a modified Didot operation, and grafted the uncovered flaps, and find it most useful.

Diagrammatically this is an ideal operation. As a matter of fact, however, it is difficult to carry out, since the flaps are seldom large enough to cover the raw surface completely. If they are sutured with much

tension sloughing is liable to occur. In fact the commissure seldom proves satisfactory if these directions are carried out.

Where the web is wide the commissure may be made by the method devised by Agnew. He raises a single large triangular flap from the dorsum, its base being at the metacarpophalangeal joint, and the apex



FIG. 200.—Bilateral syndactyly of the middle and ring fingers.—1 and 2. The middle and ring fingers of both hands are fused and there is union of the terminal phalanges in the right hand, with the terminal phalanges tilted outward of the fused phalanges. The tilting outward of the terminal phalanges of the other hand is less marked. Only one hand should be operated on at a time in these cases. 3. Two weeks after operation on the right hand. Note the tilting of the separate terminal phalanges.

which should be rounded, reaching nearly to the second phalanx of the middle finger. He then divides the web completely, brings forward the flaps, and sutures them into the palm, and then closes the edges along the fingers (Figs. 197 and 198).

In the formation of a commissure I prefer to use two pedunculated flaps, one of which is raised on the dorsum of the fused fingers with



FIG. 201.—Bilateral syndactyly, *continued*.—1. Two weeks after operation on the right hand, and one year after operation on the right hand. 2. Two years after operation on the right hand, and eight months after operation on the left hand. If the tilting of the fingers cannot be overcome by massage and splinting at night, then operative procedure is indicated. Both of these operations were done by the formation of a commissure with flaps, and then by a modified Didot operation on the fingers, with grafting when necessary.

base at the metacarpophalangeal joint, and the other on the palm. The main portion of the bodies of these flaps are on different fingers. The extremities are blunt, and when sutured they lie side by side rather than end to end, somewhat after the method of Félizet (Fig. 199).

In any operation for webbed fingers primary healing is so important, but, if the skin edges cannot be sutured without tension, we must resort to one of the methods of skin grafting to fill the defect. I have used Lier-Thiersch grafts and whole-thickness grafts with success in these cases, and do not hesitate to sacrifice the skin at the proximal portion of the web on both the dorsal and palmar surface of the fingers, in order to construct a flexible, broad commissure. Then, by a modified Z-plast operation the remainder of the web is removed, and if any defects remain, they are grafted (Figs. 200 and 201).

Pedunculated flaps from distant parts may also be used to fill in any remaining defects, and in certain difficult cases even to form a commissure.

Where several fingers are implicated it is advisable to separate only two of them at a time. When bones have been chiseled, the surfaces may be covered with grafts. There is a tendency to contraction of the scar bands after healing along the suture lines or grafted areas, and for this reason systematic massage and passive motion, together with the use of splints at night over a period of months is important. There is often a tilting of the terminal phalanges, especially in those cases in which the bones are fused. This can be gradually overcome by the use of massage and splints.

Webbing of the fingers which may be as varied in degree as the congenital variety, are encountered after severe burns. In these cases the problem is complicated by the presence of scar tissue which adds greatly to our difficulties.

CONGENITAL CONTRACTURES OF THE FINGERS

Congenital contracture of the fingers is apparently not so rare as was formerly thought. It occurs principally in girls, and usually in the little finger of one or both hands. It may occur in several members of the same family, and also in succeeding generations. I have in mind the case of twin sisters, in each of whom the little finger of both hands was congenitally contracted. In this family there had been no previous history of a similar deformity (Figs. 202-205).

The condition is usually first noticed several months after birth. Cupping of the second and third phalanges of the little finger is noted, but there is no indication of shortening of the skin or involvement of the muscle or fascia, and the finger may be fully extended. The de-

formity in this stage may be overcome by systematic massage, and the proper metal retention splint, which should be worn for several months.



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FIG. 202.—Congenital contracture of the ring and middle fingers of one hand. Male, aged 6 years.—1. The limit of extension before operation is shown. 2. The amount of extension possible after liberation of all binding tissues and the implantation of white thickness grafts.



FIG. 203.—Congenital contracture of the fingers of the left hand. Male, aged 6 years.—Note the difference in the extension as compared with the other hand. In this case there was great shortening of the skin and underlying tissues. The first phalangeal joint surfaces were also distorted from long continued flexion. When more than one finger is involved it is advisable to operate on only one, or possibly on two fingers at one time.

The second stage shows confirmed contracture with hyperextension of the first phalanx. The second and third phalanges are flexed in the same line, more or less rigidly upon the first. The finger cannot

straightened even with moderate force. There is no evidence of muscular contracture, but in most cases some contracted bands of fascia may be detected. The skin also seems to be contracted, and the articular ligaments are shortened by the long continued flexion. Later progressive contracture of the little finger is likely to occur, and other fingers may also be implicated.

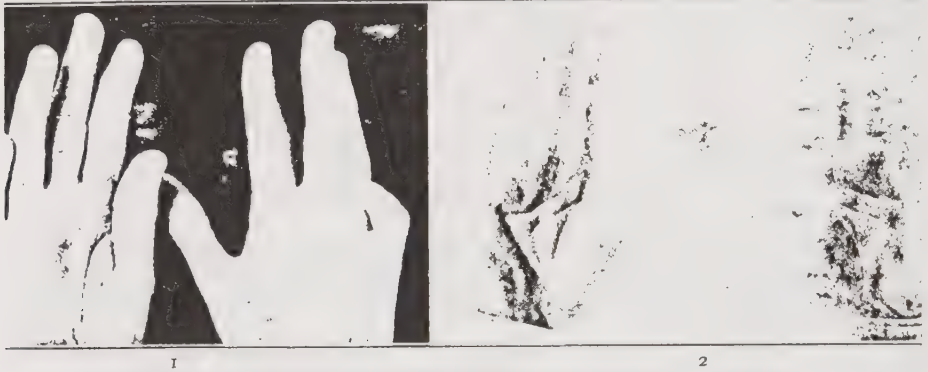


FIG. 204.

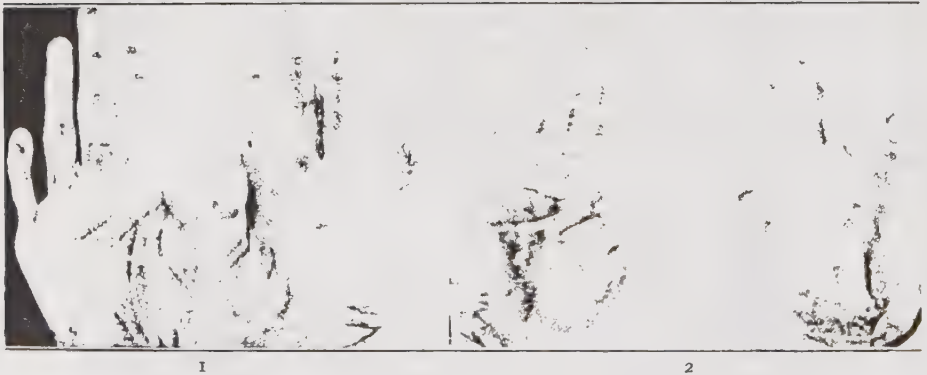


FIG. 205.

FIGS. 204 and 205.—Bilateral congenital contracture of the little fingers in twins.—and 1. Note amount of extension in both little fingers. 2 and 2. Photographs taken six months after operation. The contracted skin bands were divided by Z-shaped incisions. When the ligaments of the first interphalangeal joints were divided as far from the joint as possible, and the skin was closed after straightening the fingers. Perfect function allowed.

The contracture, which is probably primarily due to thickening of the central strip of the digital fascia, is aggravated by the shrinkage of the skin, and the gradual shortening of muscles and articular ligaments. In the old cases even the shape of the joint may become changed and in extreme cases amputation of the little finger may be necessary.

Treatment.—Adams advises the multiple subcutaneous division of all the fascia bands, and after the finger has been straightened the application of splints continuously for several weeks, and then at night for several months.

In attempting to straighten some of these deformities I have sometimes torn the skin which was greatly shortened and atrophied. In such cases I have excised the entire area with the underlying fascia, and grafted the defect with Ollier-Thiersch or whole-thickness skin graft with satisfactory results.

In two cases I have used the Z-shaped incision for the skin, excised the fascia, and been able to close the defect. In two other very marked cases, after completing the above procedure I was unable to straighten the finger until I had divided the anterior and lateral ligaments of the first interphalangeal joint. The division was made on the first phalanx as far from the joint as possible. By using this procedure I was able to straighten the fingers, whose long continued contracted position prevented extension by other methods. It might be necessary in cases of long duration to lengthen a tendon, but I have not yet found this procedure necessary.

Congenital contractures differ from the Dupuytren type in that they are congenital, whereas Dupuytren's contraction is generally a disease of adult life; congenital contracture usually occurs in females, whereas in the Dupuytren variety the patients are most commonly men. In the congenital form the central portion of the palmar fascia and its lateral prolongations are never involved, consequently the first phalanx is never flexed, but is hyperextended. The skin is atrophied, but seldom if ever indurated and lumpy, a condition always present in Dupuytren's contraction.

HAMMER-TOE

True hammer-toe is essentially an hereditary condition (Adam). It may vary in extent from slight inability to extend the second and third phalanges of the toe in children, to dorsal flexion of the first phalanx and rigid right-angled flexion of the second phalanx on the first, which is rarely found in patients under 15 years of age. The third phalanx is usually on the same line as the second, its extremity resting on the ground. In some especially severe cases the third phalanx is rigidly flexed on the second, and the dorsal surface of the nail rests on the ground (Fig. 206).

Shattock has proved that the deformity is due to contraction of the

teral ligaments of the joint, or joints involved, and not to contraction the flexor tendons or plantar fascia.

In the old cases there is usually an extensive painful corn over the prominent joint, due to pressure of the shoe; when infection has

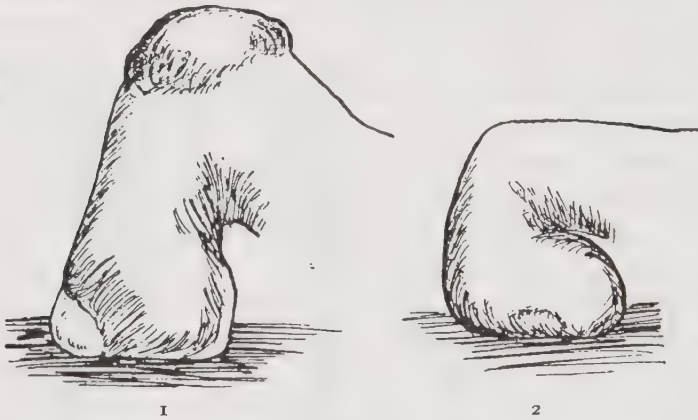


FIG. 206.—Types of hammer-toe (*Adams*).—1. The ordinary type of hammer-toe with rigid flexion of the second phalanx on the first. 2. An unusually severe form of hammer-toe, with the third phalanx flexed on the second.

occurred and the joint has been involved there may also be destruction of the joint, and bony ankylosis in this position. The second toe is usually affected, but any of them may be involved to a lesser degree.

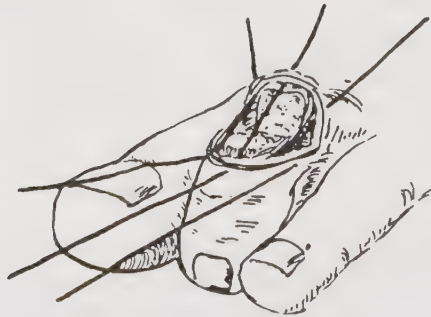


FIG. 207.—Operation for the relief of hammer-toe (*R. Jones*).—An oval piece of skin including the corn is excised over the prominent knuckle. A wedge, base upward, sufficiently large to allow straightening of the toe and including the joint, is then excised. The flexor tendon is divided, and the wound is closed.

Treatment.—Amputation is probably the most common method of treatment, but this should be regarded as a last resort. The flexor tendons have often been divided, but with little benefit. In cases without bony ankylosis subcutaneous division of the contracted lateral

ligaments, as practised by Adams, in conjunction with the use of the proper corrective apparatus afterward, is often sufficient to relieve the deformity.

Various methods of arthroplasty (O'Neil and others) have been tried with some success, but the operations are complicated, and the result are no better than those obtained by simpler methods.

Through lateral or dorsal incisions the head of the first phalanx has been removed (Wheeler), and the toe straightened. The articulating surfaces of both bones have been removed through similar incisions either by transverse (Soule and others) or wedge excision (R. Jones and ankylosis produced in the extended position (Fig. 207).

In a case in which there is an extensive corn, which has not been removed in exposing the joint, it will usually be found that there is sufficient relaxation of skin after reduction of the deformity to allow the excision of the corn and suture of the skin edges.

A corrective splint should be used for some time in the shoe, and also at night.

The results are good. My preference, in cases without joint involvement, is to try the simple method of division of the lateral ligaments first with excision of the corn. In the more extensive cases, excision of the head of the proximal phalanx, or a wedge excision of the joint, should be done.

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CHAPTER XI

HARELIP AND CLEFT PALATE

No surgeon who has had much experience with this work will deny that cases of harelip and cleft palate are difficult to handle properly. There is no group of cases referred to the plastic surgeon in which good results are more important, or in which bad results show so plainly.

Harelip and cleft palate are congenital deformities, due to the failure of union of the embryonic processes entering into the formation of the lip and palate.

Incidence of Harelip and Cleft Palate.—Harelip is more frequently found in males (73 per cent in my series), than in females. The left side is more frequently implicated (80 per cent in my series). It is said to occur once in about 2400 infants. Turnure quotes Hang's statistics dealing with the relative proportion of the types of harelip: simple unilateral harelip without bone involvement, 25 per cent; simple bilateral harelip without bone involvement, 3 per cent; complicated (bone involvement) unilateral harelip, 49 per cent; complicated bilateral harelip, 23 per cent. The percentages in my own series of cases practically coincide with these figures.

The reason for the failure to unite is not definitely known, although a number of theories have been advanced to account for the malformation. Hereditary tendency is found in from 15 to 20 per cent of the cases, in my series in 19 per cent. Great difference in the ages of the parents has been noted as a cause in some cases. As an offset to this I have seen a number of cases in which although the parents were between 20 and 30 years of age and in the most vigorous health (with no family history of any such condition on either side), the first child was terribly deformed by a complete harelip and cleft palate, whereas the children born subsequently were perfect.

Amniotic adhesions, malnutrition of the mother, injury early in the pregnancy, which is not sufficiently severe to kill the fetus, and syphilis, have all been considered possible etiological factors and must be borne in mind. I have seen several cases of harelip with cleft palate in children with definite congenital syphilis, but do not consider that this infection is a common cause of the deformity.

In some cases of harelip and cleft palate the mother eagerly proffers history of a fall, a fright, or of having seen someone with a harelip during the pregnancy, to which she attributes the deformity. In my series maternal impressions were noted in 9 per cent of the cases. The majority of these impressions take place late in the course of the pregnancy, and can have nothing to do with the defect, as can be seen from the following table taken from Berry & Legg:

"**FETAL LIFE.**—*Fourteenth day.* Appearance of primitive mouth or stomatodeum. *Fifteenth day.* Disappearance of bucco-pharyngeal membrane. *Third week.* Mandibular arch of either side forms maxillary processes bud out from mandibular arches. *Fifth week.* Fronto-nasal process appears; olfactory pits widely separated by the primitive nose; globular processes appear. *Sixth week.* Union of lateral nasal with maxillary processes; division of stomatodeum into an upper cavity, the nose, and a lower cavity, the mouth. *Eighth week.* Union of the three portions of palate commences anteriorly; completion of upper lip by fusion of the globular processes. *Tenth week.* Completion of union of the palate segments, the uvula being the last to be completed."

Associated Deformities.—It is rare to find other congenital deformities associated with harelip and cleft palate, but I have seen several cases in which club foot was also present. Cases associated with polydactylism and V-shaped notches of the lower lip and congenital hernia have been reported.

VARIETIES OF HARELIP

A. INCOMPLETE HARELIP, in which the fissure does not extend into the nostril.



FIG. 208.—Single incomplete harelip.—1. Note the notch in the lip and the thinning of the tissues into the nostril. 2. Result of operation.

B. COMPLETE HARELIP, in which the fissure extends into the nostril.

C. MEDIAN HARELIP.

A. Incomplete harelip may be subdivided into (1) *Single (unilateral) harelip*. The nostril may or may not be widened. The palate may or may not be involved. (2) *Double (bilateral) harelip*. The nostrils may or may not be

widened and flattened. The palate may or may not be involved.

B. Complete harelip may be subdivided into (1) *Single (unilateral) harelip*. The nostril is always widened and flattened. This for

often associated with cleft palate. (2) *Double (bilateral) harelip* often associated with cleft palate. The nostrils are always widened and flattened. (3) *Double complete and incomplete harelip*. Complete on one side, incomplete on the other. It may or may not be associated with cleft palate.



FIG. 209.—Incomplete harelip, right side.—1. Before operation.—2. Result of operation. There was no palate involvement in this patient.

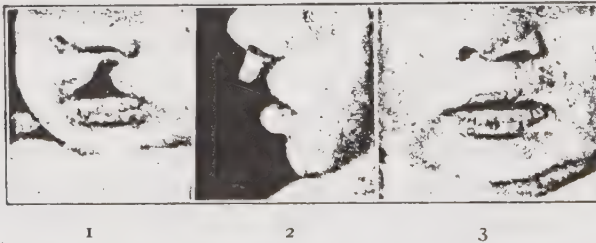


FIG. 210.—Complete single harelip (left side) associated with complete cleft palate.—1. Condition before operation. Note the projection of the intermaxillary bone. 2. Lip was closed over the projecting bone by a modified Thompson operation. 3. Result six months after operation. Note the nostril and the length of the lip.

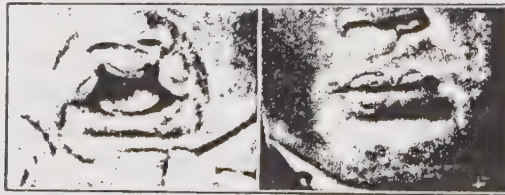


FIG. 211.—Double incomplete harelip with double complete cleft palate.—1. The skin between the top of the cleft and the nostril was thin, and had to be excised. 2. Taken two and a half years after repair of the lip. The palate had been successfully closed in the interval.

C. Median Harelip (Rare).—This may vary in extent from a simple notch in the midline to a fissure involving the entire lip and lower portion of the septum.

VARIETIES OF CLEFT PALATE

A. Incomplete cleft palate, in which the cleft does not implicate the alveolus.

B. Complete cleft palate, in which the cleft implicates the hard and soft palates, and extends through the alveolus. The extent of the cleft varies considerably.

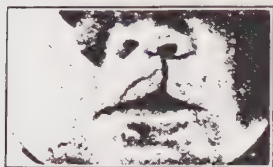


FIG. 212.—A single incomplete harelip.—The margins of the cleft were close together and were easily approximated. In a case of this type it is advisable to excise the thinned tissue just below the nostril and proceed as in a complete harelip.

A. Incomplete cleft palate may be subdivided into (1) *Cleft of the soft palate alone*. This may implicate only the uvula or the entire soft palate may be cleft. (2) *Cleft of hard palate as far as the alveolar margin, in addition to the soft palate*. The extent of the cleft in the hard palate may vary from a notch in the posterior portion to one im-

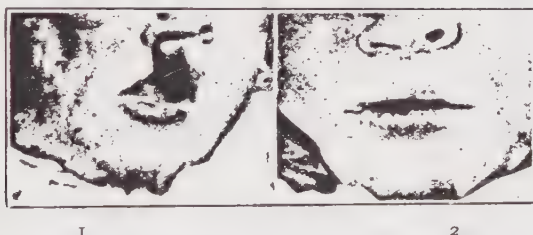


FIG. 213.—Complete harelip; right side. Cleft of the alveolar margin.—1. Before operation. 2. Four years after operation. The lip is very satisfactory, but the nostril is slightly lower than it should be. There was no palate involvement in this case.

plicating three-fourths of the entire palate. Occasionally we find a definite notch or even separation on one side at the junction of

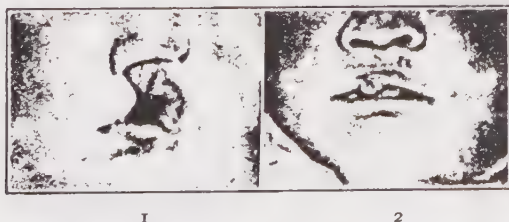


FIG. 214.—Complete harelip and cleft palate, right side.—1. There are ten children in the family, the second and tenth had harelip and cleft palate. Before operation. 2. One year after operation. Too much allowance was made for shrinkage of the scar, and the excess of projecting vermilion border should be removed to make the lip perfect.

the intermaxillary bone with the maxilla, without malformation of the hard or soft palate.

B. Complete cleft palate may be subdivided into (1) *Single (unilateral) cleft palate*, which is usually associated with a complete harelip



FIG. 215.—Complete harelip and cleft palate, left side.—1. Before operation. The intermaxillary bone on the left side projects markedly. 2. Two weeks after operation. The stitch marks will gradually disappear.

on the same side, and projecting intermaxilla on that side. (2) *Double (bilateral) cleft palate*. This is usually associated with a complete

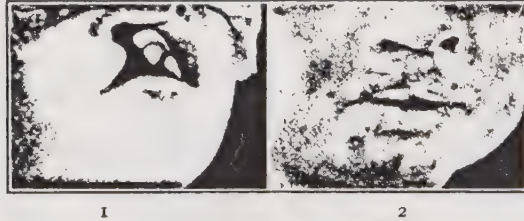


FIG. 216.—Complete harelip and cleft palate, on the right side.—1. Note the wide intermaxilla and the projecting intermaxilla.—2. Taken ten days after operation. The lip was sutured over the bone without reducing it. The marks of the stitches can still be seen. This patient returned to the hospital six months later for the repair of the palate. The intermaxilla had during this time practically assumed its normal position, and the cleft had narrowed considerably, thus simplifying the operation.

In the case of double harelip, the entire intermaxilla projecting forward as a snout.

In the group involving the alveolus the extent of the defect in the

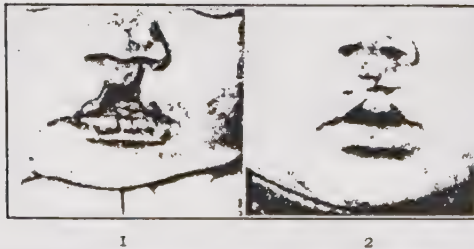
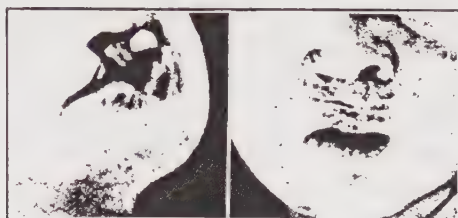


FIG. 217.—Double harelip, complete on the left side, incomplete on the right. There is also complete cleft palate on the left side.—1. Before operation. 2. Ten days after operation. Note the projecting teat of vermilion border in the midline to counteract the tendency to shrinkage.

The extent of the defect may vary considerably and numerous combinations are found. In the case of complete cleft palate, either single or double, the palate defect is usually

in or close to the midline, back of the attachment of the intermaxillar bone. The nasal septum may be in the midline unattached to the edge of the cleft. In other cases it may be attached to one side of the cleft and always to the side opposite to that on which the harelip (if it is present) is situated.



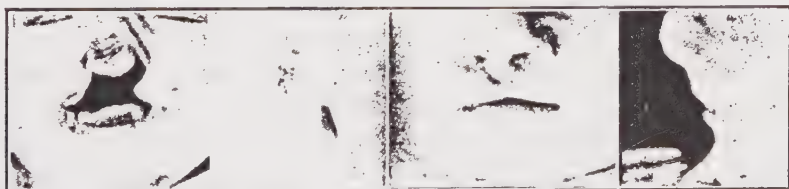
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FIG. 218.—Double complete harelip and cleft palate.—1. The intermaxilla project as a snout. It was placed in proper position by the excision of a wedge of the cartilaginous septum removed submucously. 2. Result ten days later. Note the stitch marks which are still present. Also the nostrils, the length of the upper lip and the absence of constrictions.

In the great majority of instances central holes in the palate are due to disease (syphilis, tuberculosis, typhoid ulceration), or trauma, although occasionally the defect is unquestionably congenital in origin.

Proper Sequence of Operative Procedures

Some surgeons insist that the palate should be operated on *before* the lip in all cases of cleft palate associated with harelip, since they claim



I 2 3 4

FIG. 219.—Double complete harelip and cleft palate.—1 and 2. Note the width of the gap and the snout formation. The intermaxilla was replaced by the submucous removal of a wedge of the septum, and the lip was closed by a modified Thompson operation. 3 and 4. The result one month after operation. Considerable improvement may still be made by secondary operations. Note the good position of the nostrils, and that there is no depression of the lip.

that the gap in the lip gives better access to the palate. At first sight this might seem reasonable, but in actual practice the closed lip seldom limits the exposure. My own preference for closure of the lip first is based mainly on the fact that in the majority of cases the constant pressure of the muscles of the lip will cause the margins of the cleft in the alveolus

and palate to approach each other. Blair holds that this occurs in only 50 per cent of cases, but so far as my experience goes, the percentage is considerably larger. In some cases spontaneous closure of the alveolar margin will be caused by this continuous lateral pressure, and it is extraordinary how much the gap in the hard palate can be narrowed in this way. I have had a number of cases of complete cleft palate with a single alveolar cleft, associated with projecting intermaxillary bone, in which the width of the cleft almost precluded the possibility of successful closure. After restoration of the lip the cleft was so narrowed in the course of a few months that the operative procedure for closure of the palate was relatively easy.



FIG. 220.—Double complete harelip and cleft palate.—1 and 2. Note the width of the gap and the marked snout formation. The condition of the child was so poor that the intermaxilla was replaced and held in position by wire sutures first, and several months later the lip was closed. 3. Taken eight months after closure of the lip. Secondary sping operations must be done to obtain the desired result. The mother of the patient expressed some annoyance when she found that a scar was present when she took the child home.

Early closure of the lip, has of course, no effect on the width of the cleft in cases of incomplete cleft palate, when the alveolar margin is not effected. In these cases the lip should be closed first for cosmetic reasons, and to allow nursing, which may be taught in some cases.

Time of Operation.—I have closed double, very extensive complete harelips, in which the question of nourishment was a matter of vital importance, within 12 hours after birth, but prefer to wait for several weeks (preferably from six weeks to four months). If a child cannot be properly nourished a chance should be taken even if the physical condition is poor; otherwise it is advisable to wait until the patient is thriving. This point I consider of such importance that I sometimes keep children in the hospital for weeks before operating, until with the help of a skilled pediatricist the desired condition has been brought about. In this way lives are certainly saved, and I attribute my very low mortality in harelip and cleft palate cases in some part to this precaution. Blair, Brophy, Lane and a few other surgeons advocate operating on

cases of cleft palate within a few hours after birth. My experience has been that it is better to wait until the full benefit of the lip closure is obtained and the cleft is narrowed as far as possible. I prefer to operate when the child is from eight to eighteen months old, and in my series the results have seemed to justify the delay.

Are We Justified in Operating on Adults with Harelip or Cleft Palate?—There is no reason whatever why these older patients suffering from one or both of these malformations cannot be operated on successfully. Some of them have learned to speak distinctly, to smile well, and to eat solid food without difficulty. A successful closure of the

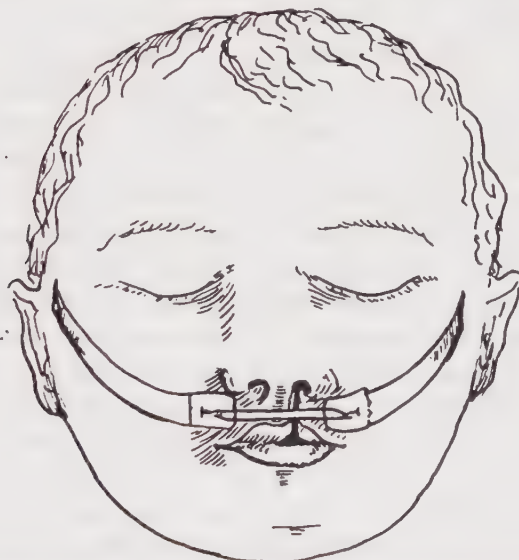


FIG. 221.—Method of narrowing a cleft by means of continuous elastic tract (Sherman). The inner end of the plaster is placed on the cheeks just outside of the mouth. The outer ends extend upward and outward as high as the top of the ear. Note the band and the elastic band in position.

palate in these cases will probably cause little improvement in the speech, but closure of the lip, when associated with a complete cleft palate, will transform a monstrosity into a fairly normal looking individual.

Preliminary Care.—Nutrition should be brought to the highest state. The child should become accustomed to being fed from spoon, medicine dropper, or small glass syringe, since nursing, either from the bottle or breast should not be allowed for at least ten days after the operation. In older children adenoids, tonsils, and decayed teeth should be attended to before an operation for cleft palate. I consider it unwise to operate if the hemoglobin is under 75 per cent.

The cleft may be narrowed somewhat, while awaiting operation, by drawing the margins of the lip fissure toward each other, and holding them in this position with strips of adhesive plaster to which hooks are attached, so that continuous elastic traction can be exerted with small rubber bands (Fig. 221). For several days before operation the throat and nose should be sprayed with an antiseptic solution—Boulton's solution (one-half strength), Dobell's solution (one-third strength), or the alkaline antiseptic solution of the National Formulary.

The urine should be examined especially for acetone and diacetic acid, and the child should be given bicarbonate of soda by mouth every four hours for several days before operation as a precaution against possible acidosis.

Anesthesia.—General anesthesia is necessary in operating for harelip and cleft palate. I prefer ether given as heated vapor, either through a nose tube or through a tube in the mouth gag. Intratracheal anesthesia in older children is of great benefit and eliminates the danger of aspiration pneumonia. It may also be necessary to give a primary anesthetic when removing the sutures from the palate.

POSITION DURING ANESTHESIA.—Many operators prefer to have the patient held in a sitting position during the operation for harelip and cleft palate. My preference is to have the patient lying down with the head supported by a well-padded circular head-rest attached to the table. In cleft palate operations the head should be lowered in the Roser position, care being taken to support its weight with a padded head-rest.

Preparation of the Part.—The lip and adjacent portions of the face should be washed with ether or benzine, and then painted with one-third strength tincture of iodine. The field should be isolated with properly applied sterile drappings.

TREATMENT OF HARELIP

Points to be Observed in All Types of Harelip Operations.—Tension must be thoroughly relieved by separating the lip, cheek and nostril from the underlying bone. This separation is most conveniently effected with a pair of curved Mayo scissors. In some instances it is necessary to carry the undercutting outward under the cheek for a considerable distance in order that the edges of the cleft may be brought together without tension. The margins must be freshened in such a way that *the raw surface on either side is of the same length* and the sur-

faces to be approximated should be as broad as possible. The denudation of the margins of the tissues should be planned so that when the suturing is done the sutured line will be slightly longer than the length of the lip thus allowing for subsequent shrinkage. This must also be planned for in cutting the vermillion border and a small projecting teat should be left to avoid a notch after healing is complete. The parts should be approximated as far as possible in their normal positions, especially the muscle elements. This has an important bearing upon the restoration of motion of the upper lip. Skin should be sutured only to skin, and mucous membrane to mucous membrane, as unsightly defects often result if this point is not carefully observed. Every effort should be made to bring up and secure in place the flattened nostril, so that it will resemble its normal fellow. When the edges of the fissure are thin, the skin and the mucous membrane should be carefully split and spread apart without removing any marginal tissue, except the upper and lower portions of the fissure, where partial excision is necessary in order to make the desired approximation. In this way the lip at the sutured line can be considerably thickened, and broad raw surfaces approximated. Care must be taken that the lip be at least long enough to cover the gums completely. There should be very little, if any, tension on the sutures, and any blanching of the tissue when the edges are approximated means that the sutures are tied too tightly or that the tension has not been properly relieved. The mucocutaneous line of the newly formed upper lip should be an unbroken curve from one side of the mouth to the other.

It is unnecessary to apply any of the various methods devised for relieving tension on the suture line—adhesive strips, metal springs, etc.—if the operation is properly performed, and I have long since abandoned such apparatus without regret.

HEMORRHAGE, which is quite violent immediately after denudation or undercutting, can usually be controlled by packing, or properly applied pressure. Ligature of the vessels is seldom necessary. There are a number of lip clamps on the market which are placed near the corners of the mouth to control the coronary arteries, but none of them are quite satisfactory and one soon discards them as unnecessary.

Operations for Single Incomplete Harelip

The incisions shown in the operations of Malgaigne or Nélaton are good, and these incisions may be modified to suit conditions (Figs 222 and 223).

When there is a notch in the lip and a wide nostril on that side, J. H. Mayo makes a horizontal incision across the floor of the nostril, and after wide undercutting converts it into a vertical wound which he



FIG. 222.—Malgaigne's operation for single incomplete harelip (*Binnie*).—1. The dark lines indicate the incisions through the thickness of the lip. 2. The flap pulled downward. The edges are then approximated, skin to skin and mucous membrane to mucous membrane. The excess tissue is removed from the free ends of the flaps.

figures. In this way the notch is lowered and the width of the nostril is reduced. The incision extends through the full thickness of the lip (Fig. 224).



FIG. 223.—Operation for single incomplete harelip (*Nélaton*).—1. The dark line indicates the incision through the lip parallel to the notch and above the vermilion border. The loop of tissue drawn downward. 3. The wound closed in a vertical line. Shrinkage of the scar usually reduces the apparent over-correction.

In all cases of incomplete harelip in which there is a groove to the nostril and the tissues are thin, it is advisable to convert the defect



FIG. 224.—C. H. Mayo's operation for incomplete harelip (*Binnie*).—1. The dotted line AB indicates the transverse incision through the lip. 2. Traction is made on the midline of the lower lip of the wound, and the edges are brought together vertically, and sutured.

into the complete variety and to bring thick well-nourished tissues together.

Operations for Complete Harelip

The diagrams of the incisions recommended in the various book on surgery are in many instances not only complicated, but for the most part wrong in principle. In actual practice it is almost impossible to use these incisions, if we wish to unite the tissues which normally should be in apposition. After a careful study of the various methods extending over a number of years I have abandoned all the complicated procedures for complete or nearly complete harelip and have based my procedures upon the fundamental principles evolved by J. E. Thompson in his operation for single or double harelip. Of course Thompson's operation as he describes it, cannot always be followed absolutely, but with modifications to meet the conditions it has proved itself by far the simplest and most efficient for general use.

G. B. New has recently reported the procedure used at the May Clinic, which is based on Thompson's operation. His illustrations are most instructive (Figs. 225 and 226).

W. E. Ladd's operation which I have found useful, is also based on correct measurements of the denuding incisions.

Thompson's Operation.—"1" represents a case of single complete harelip. For purposes of convenience the red line of the lip has been represented as symmetrically placed on each side of the cleft. At A and A' the boundary between the cleft and the margin of the nostril is marked by a sharp projection or shoulder. A pair of sharp pointed compasses, regulated with a screw is used, and a measurement (YZ) taken from the level of the opposed corners A and A' directly downward, of such length that Z would lie on an imaginary line KL , which would complete the natural curve of the upper lip. The points of the compasses are now fixed apart at this distance (YZ) and measurements are taken in the lip on each side of the cleft (shown in 2) commencing at A and A' respectively and passing to B and B' . The points B and B' are each close to the junction of the skin with the red line of mucous membrane, and are so placed that AB is equal in length to $A'B'$ and each one is the same length as YZ . The points B and B' are permanently fixed by pricking the skin with the points of the compasses until the blood appears.

The compasses are now readjusted and a measurement BC is taken the point C being on the free margin of the lip. The angle which B makes with AB is usually about 60° but varies somewhat. It must always be less than 90° , if a projecting prolabium is to result from the

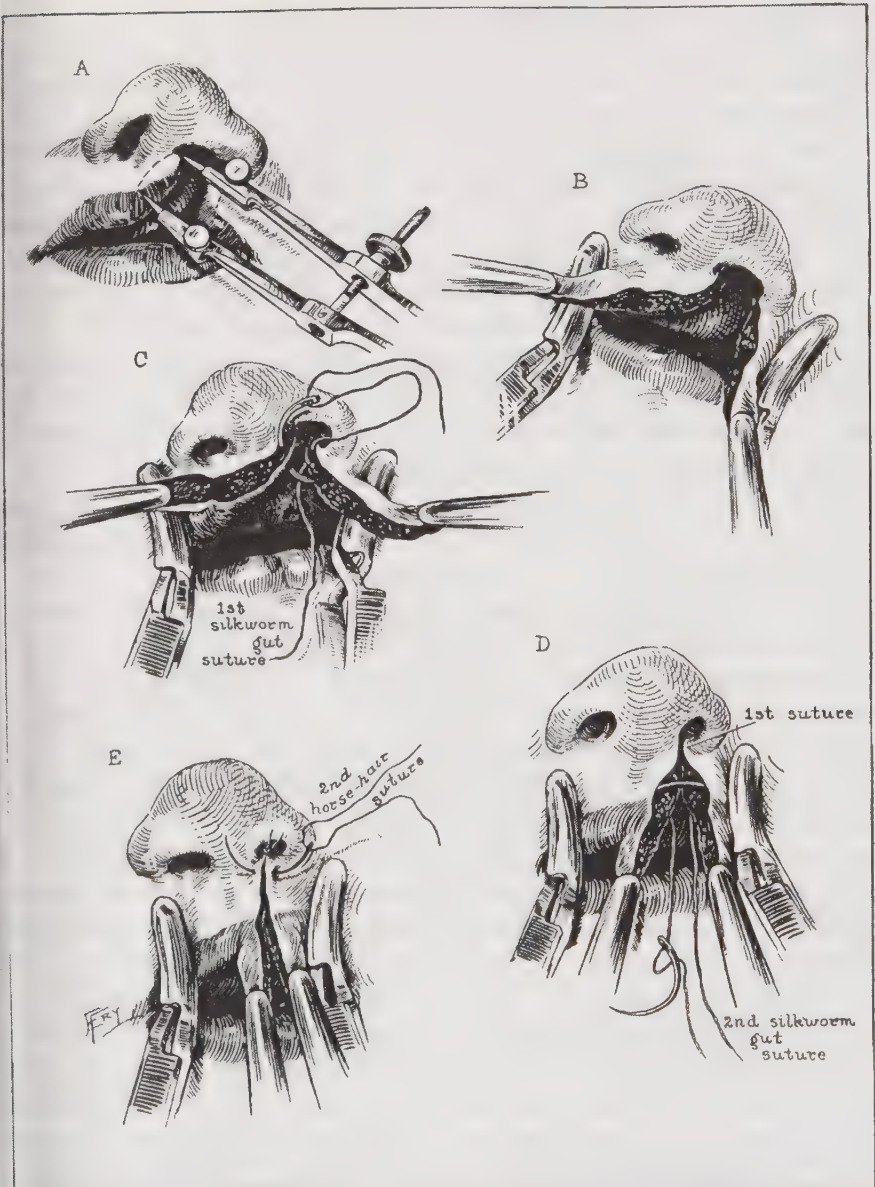


FIG. 225.—Operation for single complete harelip (*New*).—A. The calipers determining the length of the incisions to be made. The dotted lines indicate the incisions which terminate at the vermilion line and which are of equal length on each side. B. The mucocutaneous margins have been pared and the lip has been thoroughly freed from the bone on each side. The small clamps on either side of the lip are to control bleeding. C. The first silkworm gut suture to form the nostril is inserted from the inside and does not penetrate the skin. D. The first silkworm gut suture is tied and the second is placed. E. The lip is approximated with horsehair.

completed operation. A similar point C' is taken on the other side of the cleft. Both C and C' are pricked with the points of the compass. Being now ready to denude the sides of the cleft the operator passes

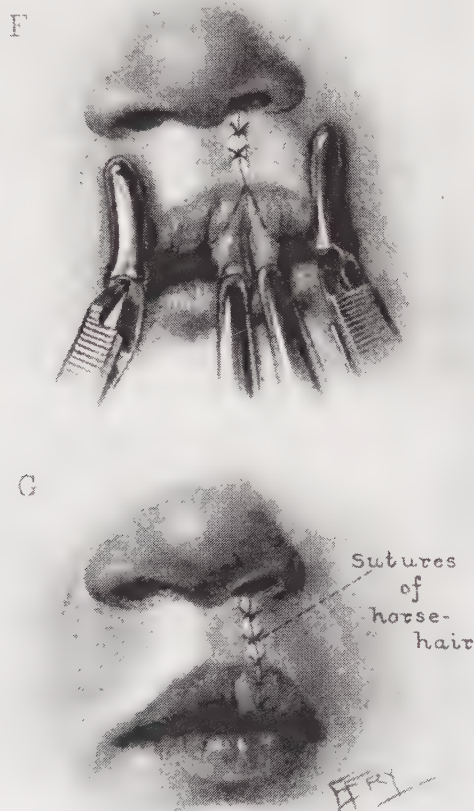


FIG. 226.—Operation for harelip (New).—F. The dotted lines on the vermilion border indicate approximately the incisions made to complete the red line of the lip. The lip completely closed with horsehair sutures.

retaining stitch of horsehair through each side of the mucous membrane of the lip close to, but below, C and C' . The lip is transfixed with narrow-bladed knife at B , and the knife is carried with a sawing sweep in a slight curve to A , where it emerges exactly at the shoulder. T

lip is then divided along the line BC and the tissue outlined by ABC is removed. The same maneuver is carried out on the opposite side of the cleft, the knife passing along the line $A'B'C'$.

As a result we now have two raw surfaces opposed to one another, the corresponding sides of which are equal in length. Thus AB is equal to $A'B'$, and BC is equal to $B'C'$.

If A be united to A' , and B to B' , and C to C' , the sides of the wound between these points can be brought into apposition with accuracy and perfect lip will result, such as is shown diagrammatically in 3.

In 4 the same operation is shown on a lip in which the sides of the cleft are divergent. In order to get sufficient depth to the lip,

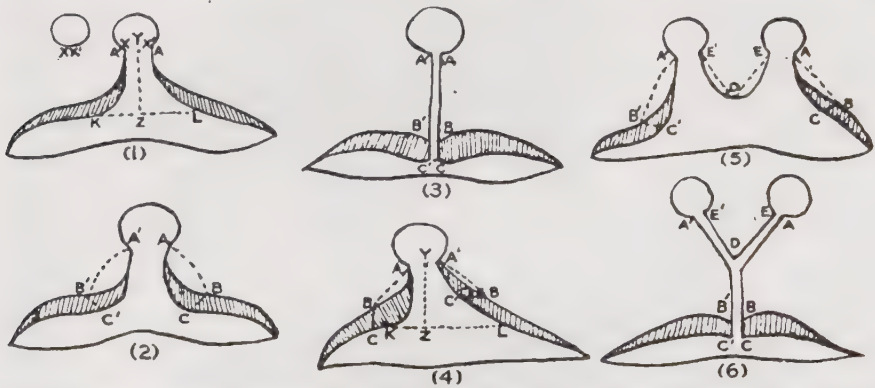


FIG. 227.—Diagrammatic representation of Thompson's operation for single and double harelip.—A full description will be found in the text.

the points B and B' will necessarily be very far apart, but can be brought together with very little tension if the cheeks have been well loosened beforehand. Otherwise the steps of the operation are identical with those shown in 2 and 3.

The treatment of double harelip is shown in 5 and 6. The shoulders marking the margins of the nostrils are shown at A and E , and at A' and E' . The triangle $E'DE$ shows the line of incision by which the central piece of skin covering the intermaxillary bone is pared. A and E' are placed on the inner margins of the nostrils. The sides AE and DE' are usually equal in length to one another, and their length varies according to the depth of the central piece of skin. It must never be greater than AB and is usually much less. The points B , B' , and C , and A' , B' , and C' , are chosen as described previously in the operation on single harelip. 6 shows the final appearance of the lip when the flaps have been cut and the parts approximated. The

point A is in contact with E ; A' with E' ; the apex D , of the triangle $E'DE$, lies somewhere along the line AB ; the point B is in contact with B' , and C with C' (Fig. 227).

Two essential points must be emphasized: Under no circumstances must the circumference of the nostril be encroached upon. The shoulders that represent the margins of the nostril must be accurately approximated. The points B and B' must be as close to the red line of the lip as possible, and must always be on the skin (upper side) of this line.

The various parts of the lip resulting from this method of operating are reproduced from elements normally present. They are free from

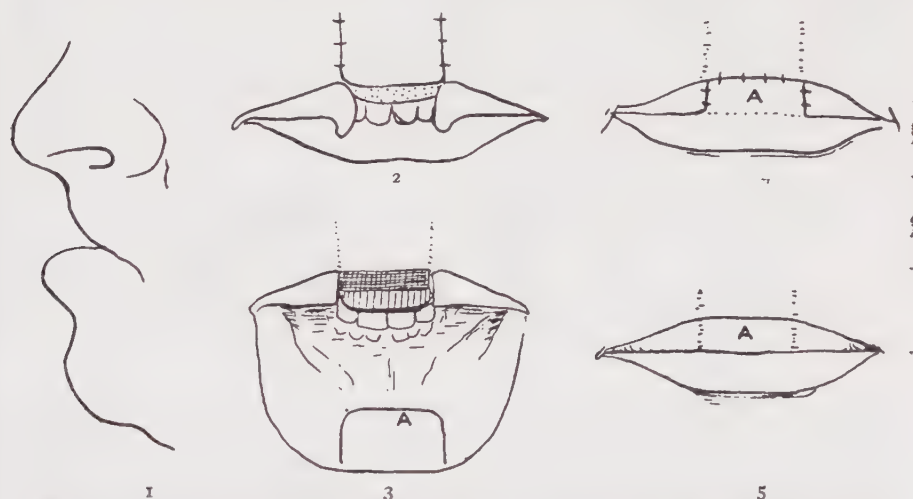


FIG. 228.—Operation for double harelip in cases in which the vermilion border cannot be closed (*Lexer*).—1. Profile in double harelip. 2. The vermilion border which is too short to be sutured together. 3. A flap from the lower edge of the philtrum is turned down. Outline of flap A of mucosa and sub-mucosa from the lower lip. 4. Showing the flap A in position sutured to the raw surface of the philtrum, and to the edges of the vermilion border. 5. Result after cutting the pedicle from the lower lip and shaping.

the admixture of tissues of different texture and consistence. The nostril is formed entirely from the original nostril ring, and the parts consisting of skin and mucous membrane from skin and mucous membrane alone.

Symmetry thus results, the nostril being of the proper size, the cutaneous portion of the lip of the right depth, the mucous membrane of the proper width, and the red line of the lip running from side to side without break or fault.

Dr. W. E. Ladd has devised a good operative method which is applicable to any variety of single harelip. He uses two pairs of split angula clamps, with fine teeth to prevent the skin or mucous membrane from

lippling, and a small thin double-edged knife. These instruments he employs in conjunction with an ordinary pair of small sharp-pointed metal dividers (Fig. 229).

The distance is measured from the septum *B* on the normal nostril, and from the edge of the ala (*D*) on the cleft side. With the mouth closed the desired height of the lip, minus the width of the vermilion border, is determined with the dividers. This distance is then marked off on either side of the lip by pricking with the sharp ends of the dividers at the points *A* and *B*, and *C* and *D*, which are to form the lines

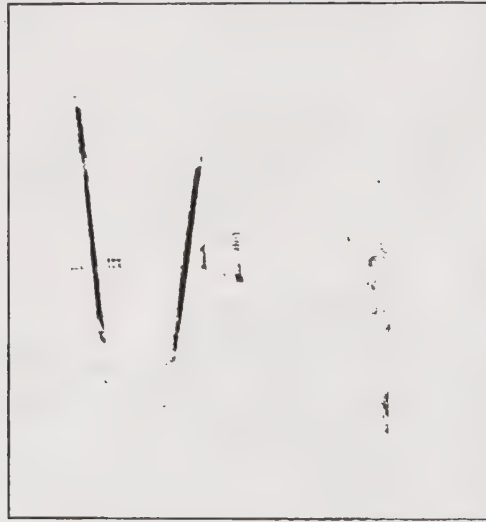


FIG. 229.—Ladd's slotted angled clamps.—1. Note the fine teeth in the jaws of the clamp, and also the screws by which the clamp is adjusted as snugly as desired. 2. The slotted angle is well shown. The knife is inserted in this slot and in this way the measured incisions are cut with absolute accuracy.

of the incision. The lip and cheek are then freed from the alveolar process and superior maxilla on both sides until the edges of the fissure can be drawn together without tension. The clamps are then applied—the angles of the slits being at the points *A* and *C*—and the slits are directed toward the points *B* and *D*. The lower puncture points should be in the center of the angles. The knife is now introduced into the slit in the clamp, carried upward to the nose, and downward through the border of the lip, making the incisions *BAE* and *DCF*. The clamps are now removed, and, when necessary, are reapplied near the corners of the mouth to control hemorrhage, but should not be kept on long enough to cause edema.

The edges of the two incisions, which of necessity must be clean cut, of equal length and consequently fitting each other, can now be easily approximated, bringing the points *B* to *D*, *A* to *C*, and *E* to *F*. This is done with one row of interrupted silk stitches, which include all layers but the skin and are tied inside the lip. A subcuticular suture of fine silk is used for the skin and is placed as follows: A perforated shot having been attached to one end, the silk is carried on a straight intestinal needle from the outside of the ala to the edge of the skin wound. The thread is then drawn through and the shot is brought against the ala, thus holding it in position. The silk is then threaded on a small curved needle and a subcuticular suture is inserted down the lip from above, to the vermilion border, where it is tied to an interrupted suture which closes the vermilion line. No dressing is ap-

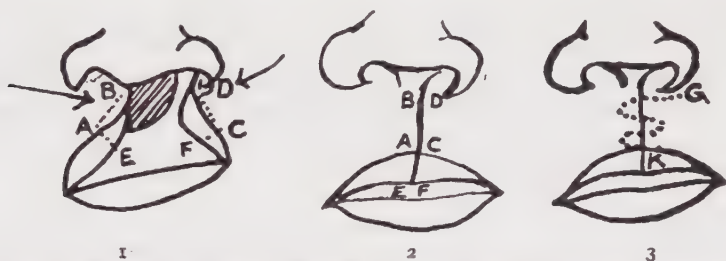


FIG. 230.—Operation for single complete harelip (*W. E. Ladd*).—1. The dotted line indicate the incisions. The line *AE* is which the desired height of the lip minus the width of the vermilion border, is pricked with dividers, and *DC* on the opposite side is made the same length. The lines *AE* and *FC* across the vermilion border are of equal length. The angled clamp is then applied, the points *A* and *C* being in the center of the angle. Then the tissue inside the dotted lines is removed by incisions along the slots of the clamps. 2. The edges which are of exactly the same length are approximated. 3. The dotted line indicates the fine silk subcuticular suture held by a perforated shot at the edge of the ala and tied at the vermilion border to an interrupted suture at *K*.

plied. The deep inside sutures are removed in ten days; the subcuticular suture in from seven to ten days (Fig. 230).

I have seen Dr. Ladd operate on several cases by this method, and have also witnessed his excellent results. In my own hands this method has proved satisfactory.

METHOD OF SUTURING.—I use horsehair with a half curved corneal needle for closing the lip and vermilion border, and fine silk (which may be waxed) for the mucous membrane. The on-end mattress suture is the best for the purpose. It is so placed that it includes a good bit of the lip tissue (muscle) down to, but not including the mucous membrane. This suture prevents a depressed scar and by its use, suturing of the mucous membrane high up under the lip is made unnecessary.

The first suture which is carried well back into the deep tissues below the ala is placed just within the nostril, and should round it in good position, but not encroach upon its size. Several special sutures for

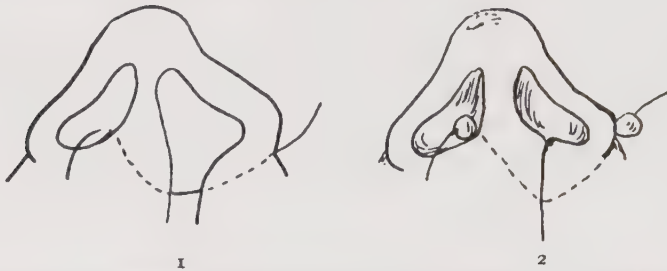


FIG. 231.—Suture to correct the flattened nostril (*Roberts*).—1. The silver wire suture in place. 2. The pared edges of the nostril brought together and the suture secured by perforated shot.

The formation of the nostril have been evolved and are shown in the diagrams. The second suture is placed at the junction of the skin and vermilion border and subsequently the rest of the incision is closed. If necessary a few very superficial interrupted sutures may be placed

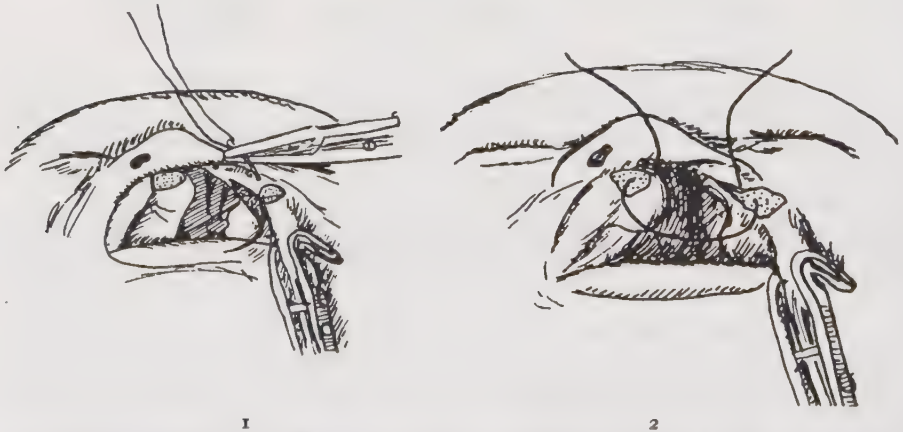


FIG. 232.—Method of inserting the stitch to shape the nostril (*Berry and Legg*).—1. After the edges have been pared the stitch is passed deeply from within the ala and is made to emerge at the upper part of the raw surface of the lip close to the nostril. 2. It is then carried across and inserted in a corresponding place on the raw surface of the nostril side of the cleft. It is inserted as deeply and as close to the cartilage of the septum as possible, and emerges inside the nostril.

between the on-end mattress sutures. The use of horsehair prevents unnecessary scarring. Two or three silk stitches should be placed in the mucous membrane of the lower half of the lip (Figs. 231 and 232).

Silver wire or silkworm gut held by perforated shot may be used to

shape the nostrils, especially in cases of double harelip. If tissues are properly mobilized, there is no need for tension sutures which always leave scars.

The superficial sutures may be removed within two or three days; the deeper ones gradually, until they are all out by the seventh or eighth day. The sutures in the mucous membrane which do not slough out should be removed.

DRESSINGS.—No dressings are necessary. I usually paint the sutured line with one-third strength tincture of iodine, and over that apply compound tincture of benzoin evaporated to a syrupy consistency. Occasionally I use a little calomel powder on the suture line.

It is sometimes advantageous to insert split rubber tubes of suitable size into the nostrils to prevent collapse. These may be removed after two or three days. Blair has suggested the use of a rubber tube in the mouth (secured by tapes) for several days to facilitate breathing until the patient becomes accustomed to breathe normally. It should be removed twice a day for cleansing, and feedings may be given through it.

The Treatment of a Prominent Intermaxillary Process

In a child with a single complete harelip and cleft palate with a projecting intermaxilla, an attempt should be made to push the bone into place with the fingers, but this is seldom successful.

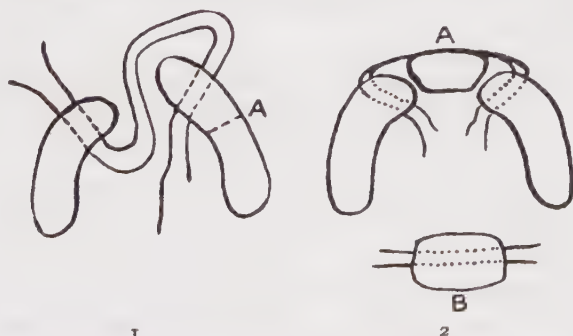


FIG. 233.—Methods of dealing with prominent intermaxillary bones.—1. The projecting portion should be pushed back into alignment. If this is not possible, sometimes the bone is partly divided at A. The two wire sutures are preferable to one long mattress suture, they are easier to remove. 2. In dealing with a prominent intermaxilla after reducing it by partial fracture, I have found silver wires, placed as shown, an excellent method of holding it in position.

Some operators chisel partly through or crush the bone with force at the junction of the maxilla with the intermaxillary bone, in this way reducing it by partial fracture (Fig. 233). This is bad practice and

the vast majority of cases unnecessary. After proper undercutting the lip can be closed over the bone and in due time will gradually restore it to the desired position.

In double complete harelip and cleft palate, with a projecting intermaxilla, it is *essential never to remove the bone*. If the prominence is not too pronounced it may be possible to close the lip over it. If it projects as a snout and closure is impossible, some method must be used to bring it back, so that the soft parts may be closed over it. In a few cases this may be effected by pressure, but this method invariably causes a deflection of the septum unless there is a fracture, in which case the reduction can easily be made.



FIG. 234.—Double harelip and cleft palate, with projecting intermaxilla (*Berry and egg*).—The dotted line indicates the incision made for the submucous removal of a wedge-shaped portion of the cartilaginous septum. After removal of this wedge the intermaxilla can be easily restored to its normal position.

A wedge-shaped piece of cartilaginous septum may be removed submucously with bone scissors after the mucosa of the septum on each side has been raised through an incision about 2. cm. ($\frac{4}{5}$ inch) long made in the free margin of the septum behind its attachment to the intermaxilla (Fig. 234). Tilting of the incisor teeth backward should be avoided, but provided that the wedge is not too wide or too high, there is little danger of this accident. In other words, as little of the septum should be removed as will allow of proper reduction. No sutures are necessary to close the incision.

Another method is to divide the septum obliquely after separating the mucosa, so that reduction of the intermaxilla will slide one part over the other.

Quadrilateral sections of the septum may be removed for the same purpose, and are said to prevent tilting back of the incisor teeth (Doye Turnure).

Reich has devised an ingenious method which prevents the tilting back of the teeth. He dissects the philtrum from the intermaxillary bone, and after exposing the cartilaginous septum divides it upward and backward as far as possible. Next, through parallel incisions in the posterior portion of the septum he separates the mucoperiosteum on each side and excises a triangle. The intermaxillary bone is then pushed back into position (Fig. 235).

It is advisable to denude the surfaces of the intermaxilla and maxillary processes where they come in contact.

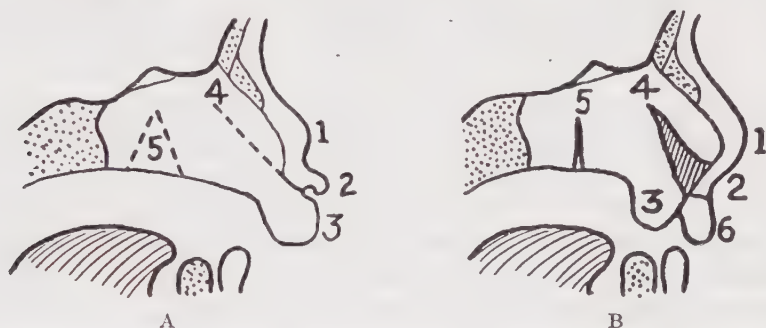


FIG. 235.—Reich's operation for repression of the intermaxilla (*Binnie*).—A. Point of nose. 2. Philtrum. 3. Intermaxillary bone. 4. Oblique section of the septum. 5. Wedge of septum to be removed. B. Shows the position of parts after removal of septal wedge and adjustment of parts.

The intermaxillary bone should be held in position after reduction and this is best accomplished by means of silver wire placed as shown in the diagram. It is better to use two pieces of wire because it is often very difficult to remove the long mattress suture which soon buries itself. This suture may be removed in two but preferably in three weeks.

In one or two cases of complete double harelip and cleft palate with the snout projection, when the patient was unable to stand the complete lip operation, I have reduced the intermaxilla by taking out a small wedge of the septum first, and later when the condition was improved have closed the lip.

Complications in Harelip

The stitches may tear out on account of too much tension, or following an infection, or the child may tear them out if the hands are not

secured. Stitches may be removed too early and the edges of the wound separate. I have had one death from pneumonia. In the series of cases at the Johns Hopkins Hospital I note deaths from hemorrhage at the time of operation, and from post-operative bronchitis, pyelitis, and status lymphaticus. Acidosis must be thought of, as it occurred in a number of my cases in spite of every ordinary precaution, and in one or two cases the patient was desperately ill.

Hemophilia must also be borne in mind when considering operative procedures for these cases. I have had two cases (one of harelip and one of cleft palate), in which this condition existed, but I was unaware of it until I was in the midst of the operation. The patient with the harelip bled for several days from the suture line and stitch holes, but finally recovered. The child with the cleft palate almost bled to death from post-operative hemorrhage. The hemorrhage was finally controlled by removal of all the stitches, packing with adrenalin gauze, and the application of digital pressure for 24 hours continuously. Horse serum was also given subcutaneously in this case.

Post-operative Care.—The child should be placed on a Bradford frame if there is any difficulty in controlling it. The hands should

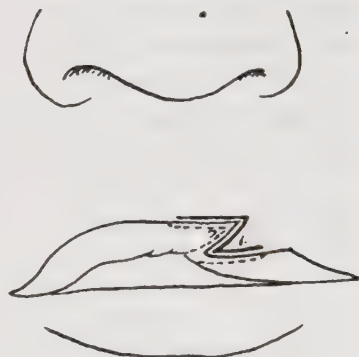


FIG. 236.—Method of adjusting the vermilion line by means of a Z-shaped incision (*Berry and Legg*).—The black line indicates the incision. The dotted lines indicate the area trimmed. The flap 1 is superimposed on the flap 2.

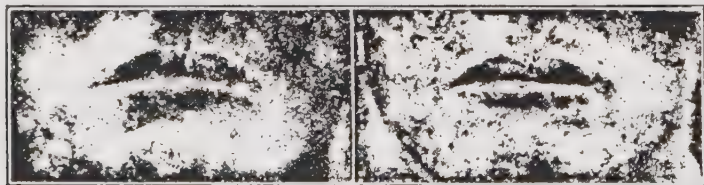


FIG. 237.—Defective result of an old harelip operation.—1. Before operation. Note the irregular vermilion line and the depressed broad lip scar. 2. After operation.

be secured so that the fingers cannot be placed in the mouth. This can be done by tying the hands, or by the use of stiff cuffs over the elbow, which hold the arms straight. Should the child be restless, small doses of paregoric may be given. Every effort should be made to keep the patient comfortable and from crying.

As a routine, if the child is old enough, water containing soda bicarbonate and lactose should be given (per rectum) by the Murphy drop method for the first 24 hours. Sterile water may be given by mouth every two or three hours for the first 12 hours, and then any sterile liquid. Soft diet may be started after a week. A mild cathartic should be given as needed.



FIG. 238.—Defective result of an old harelip operation.—1. Note the broken alignment of the vermilion border. 2. Result of operation. The lip operation had to be done over completely. There was also a complete unilateral cleft palate in this case.

It is advisable to keep the mouth clean with normal salt or boric acid solution swabs, and an antiseptic spray. The sutured area should be kept as clean as possible. Should the nostril or stitch holes become clogged with secretions the free use of sterile boric ointment will soon soften the mass, which can then be removed with a cotton swab. Nursing from a bottle with a nipple with large holes in it can be taught

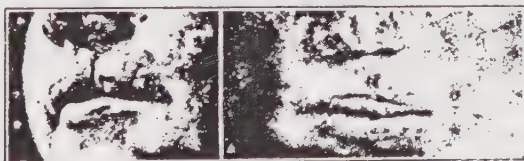


FIG. 239.—Bad result of harelip operation. Duration ten years.—1. Note the deep grooved scar and the break and notch in the vermilion border. 2. Photograph taken one year later. Note the condition of the nostril, the lip scar, and the vermilion border.

even if the palate is not closed, but this should not be started until ten days after the operation.

Secondary Operations for Harelip

Secondary operations for harelip are required in many cases for the correction of deformities resulting from imperfect primary operations.

and from accidental happenings, among which are the cutting out of sutures, and infection. Should a secondary operation be necessary, it should never be undertaken until healing is complete and all signs of infection have disappeared.

It is sometimes advisable to do slight secondary trimming operations on the margin of the lip to improve the appearance after a primary

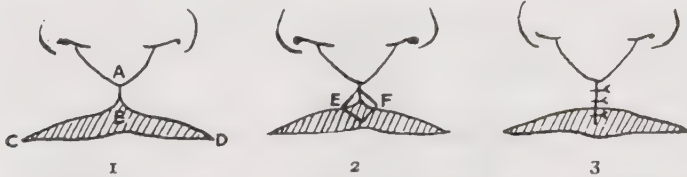


FIG. 240.—Method of correcting a notch in the center of the lip following an operation for double harelip (*Berry and Legg*).—1. The line AB represents the junction of the skin margins. The shaded area CBD the mucous membrane drawn up at the point B. 2. The black lines indicate the incisions made through the lip to remove a diamond-shaped area of tissue. 3. The points E and F are approximated and sutured, thus lowering the central portion of the lip.

operation which has otherwise been quite perfect. In some cases the nostril may also have to be raised.

In *single harelip* the entire line of union may be involved. Thus, the scar may be wide and unsightly, and the tissues thin owing to incomplete union of the muscular tissue of the lip, or the two sides of the lip may have been sutured so that they are out of alignment, one being



FIG. 241.—Types of bad results following harelip operations.—1. Note the prominence of the philtrum and the hitching up of the vermilion border. 2. The result of removal of the intermaxilla. 3. Note the closure of the nostrils. All of these cases were operated on elsewhere. All were the result of operations for double complete harelip with cleft palate.

on a higher level than the other. In both of these cases the nostril is usually flattened. The only rational method of procedure is to excise the scar completely and perform the operation as if it were the primary one. It is always more difficult to secure a satisfactory result in these cases than in one which has not been previously operated on.

Only a portion of the line of union may be defective, the rest being satisfactory; either the upper portion close to the nose, in which case the nostril is usually flattened, or the lower portion of the lip may need attention.

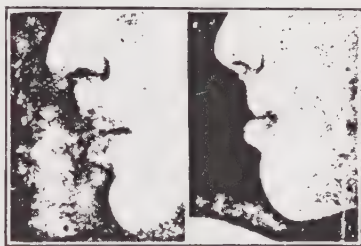
When only a portion of the lip is involved, correction may be made by excision of the defective portion only, coupled with the necessary trimming and closure, without any disturbance of the portion correctly repaired.

In *double harelip* we may have conditions similar to those described for single harelip. But in addition it is sometime difficult to close the soft parts without a certain degree of tension, even after the intermaxillary bone have been replaced. In these cases there may be



1 2
FIG. 242.

FIG. 242.—Apparent prominence of the lower lip due to defective alveolar margin in case of cleft palate. 1. The lip and palate have been closed. 2. Excess tissue has been removed from the lower lip both transversely and laterally. This patient is now under the care of an orthodontic surgeon who will be able to bring forward the alveolar margin to certain extent, and thus further improve the appearance.



1 2
FIG. 243.

FIG. 243.—Projecting philtrum following an operation for complete double harelip and cleft palate. 1. Note the projection between the columna and the vermillion line. Result of operation. Excess tissue was removed and in this instance an inclusion cyst about the size of a marrow-fat pea was found. I have never before encountered a similar cyst in a case of this kind.

separation of the margin of the lip at the midline, or a triangular area of mucous membrane may extend in this region above the normal line. Another deformity is due primarily to the prominent intermaxilla. The philtrum may project forward causing a button-shaped deformity although there may be no opening in the suture line; or the line may be broken and the intermaxilla project through its upper part, causing fistula through the lip.

In double harelip, after reduction of the intermaxilla and closure the lip is usually quite tight and relatively the lower lip projects. This is most marked, of course, in those cases in which the intermaxilla

ions have been removed. This flatness of the upper lip has given me much trouble, and I have not yet been able to overcome it to my entire satisfaction. I have removed portions of the lower lip in some cases to make the relative projection seem less pronounced. Abbe's method of inserting a pedunculated flap from the lower lip to give greater length to the upper lip and, at the same time reducing the size of the lower lip, is valuable (Fig. 244). The best results are obtained by referring such cases to the orthodontic surgeon, who is able to realign the alveolar margin and bring the upper jaw out to its proper position. Then, after this is done, the plastic surgeon can correct any minor external effects by secondary operations. It has been suggested that cartilage or bone, or fat transplants, paraffin injections, and other methods,

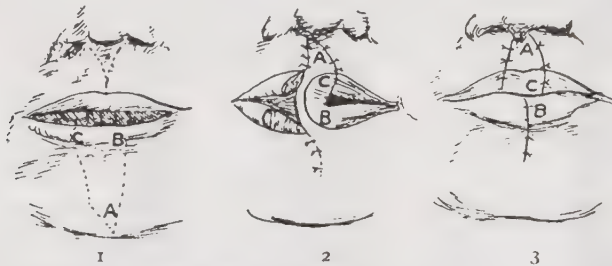


FIG. 244.—Operation for widening the upper lip (Abbe).—1. A median vertical incision is made in the upper lip, and the scar is excised. The dotted line on the lower lip indicates the outline of the flap through the thickness of the lip, the pedicle being at the point B. 2. The flap is turned upward and is sutured accurately into the gap in the upper lip. The chin wound is closed. The lips are held together by necessary retraction sutures and food is given through the nares. 3. The pedicle is cut and fitted after twelve days.

might be used to overcome the flattening of the upper lip, but none are as rational as the one just mentioned.

Secondary operation on double harelips are likely to be very extensive and very difficult. The coöperation of the orthodontic with the plastic surgeon is most essential in these cases.

THE TREATMENT OF CLEFT PALATE

The parents must be impressed with the fact that the operation for cleft palate is a serious one. There is usually considerable loss of blood. The operation is often of long duration—two hours not being excessive in some cases—and post-operative complications may occur.

The factors of the greatest importance to be considered in the repair of a cleft palate are (1) the height of the palatine arch; (2) the amount of soft tissue (mucoperiosteum) between the alveolar border on each

side and the margin of the cleft; (3) the comparative width of the cleft. Naturally, the higher the arch and the narrower the cleft, the easier it is to close the defect.

In making a flap every effort should be made to preserve a blood supply sufficient to nourish it. The nerve supply and the musculature

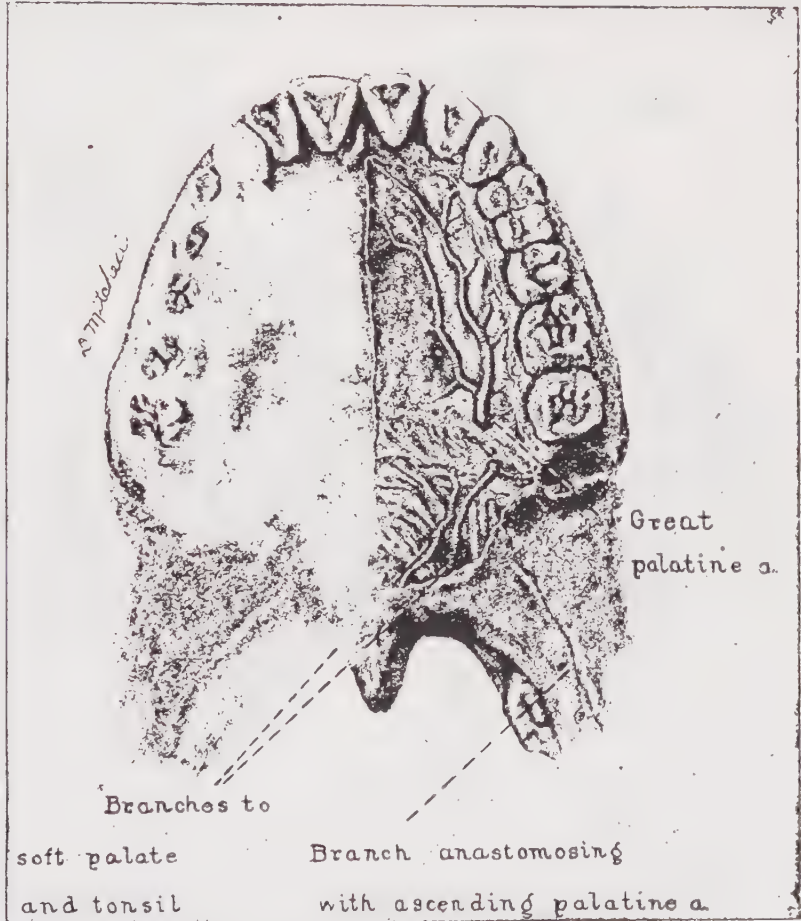


FIG. 245.—Blood supply of the palate (*New*).—Note the relationship of the great palatine artery of the alveolar process, also its branches to the soft palate. Every effort should be made to avoid injury to the artery when making relaxation incisions and when raising the mucoperiosteal flaps.

of the soft palate should not be disturbed unnecessarily. The healing should be as free from inflammatory reaction as possible, as a supple velum is most important for good subsequent articulation.

After trying various methods of closing cleft palates, I have reached

the conclusion that the edge-to-edge approximation based on Langenbeck's operation, is the method of choice. In suitable cases it can be employed in conjunction with the flap method advocated by Lane. In looking over the cleft palate cases at the Johns Hopkins Hospital I find that at least 60 per cent of the operations have been done by the Langenbeck method, and 10 per cent by the Langenbeck and Lane methods combined.

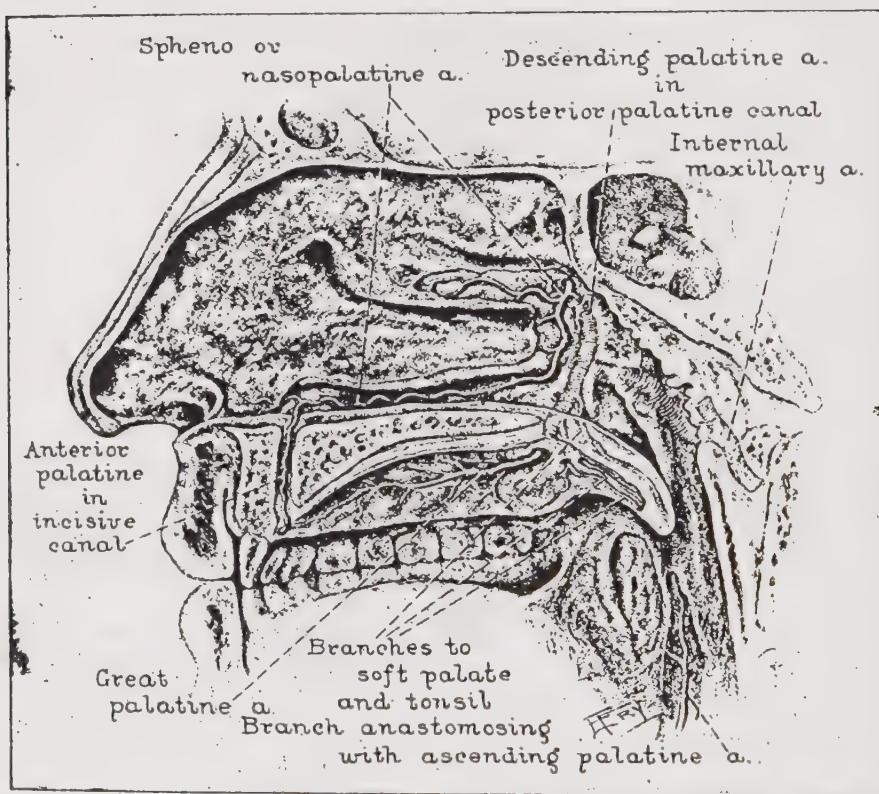


FIG. 246.—Blood supply of the palate (*New*).—Sagittal section showing the position of the anterior and posterior palatine arteries and their anastomosis.

Necessary Apparatus

Mouth Gag.—Good exposure of the cleft with proper illumination is essential if the palate is to be closed with any degree of satisfaction to the operator. The exposure can be obtained by using one of the many forms of mouth gags. I have found the Whitehead type with tongue depressor to be as good as any. Sometimes in infants a small

appendix retractor in each angle of the mouth will give sufficient exposure. Any well-constructed electric head light, or hand light will supply illumination.

Aspirator.—A continuous suction aspirator with a flexible metal nozzle is of great value and serves to keep the field clear of blood and mucus. More important still it may prevent aspiration pneumonia



FIG. 247.—Elevators useful in cleft palate work.—1 and 2. The ordinary blunt dissector, side and front views. The instrument is 15 cm. (6 inches) long and the widest portion of the blade is 0.7 cm. (about $\frac{9}{16}$ inch) wide. 3. The blunt dissector with the blade bent forward. 4. This long narrow elevator 20 cm. (8 inches) long has a blade 0.5 cm. ($\frac{1}{4}$ inch) wide at its widest portion. 5 and 6. Brophy's angled elevators. Note the difference in the angles of the blades to the shaft. These instruments are 13.75 cm. (5 inches) long, and the widest portion of the blade is 0.2 cm. ($\frac{1}{12}$ inch). All of these instruments are blunt and are used for separating the mucoperiosteal flap from the hard palate.

Knives.—Any thin narrow-bladed knife will do for making the primary incisions and for the denudation of the edges of the flaps. A rectangular knife is of use in loosening flaps, especially in the narrow angle high up and just behind the intermaxilla.

Forceps.—For handling the tissues I use a long curved pair of mouse-tooth forceps, the teeth of which are quite small.

Tissue Hooks.—Small single and double hooks are most useful for rawing the flaps together and everting the edges during suturing. They deserve more frequent use, inasmuch as gentle handling of the issues is especially desirable in these cases.

Elevators.—For raising the mucoperiosteal flaps from the hard palate, elevators of several shapes may be used. The long narrow taphylorrhaphy elevator, Brophy's angular elevators and the ordinary blunt dissector are sufficient (Fig. 247).

Needles.—A small-sized full-curved needle (Lane's) is the best for the ordinary sutures. In closing the mucoperiosteal flap it is sometimes difficult to place the sutures with a free needle; in these cases I use a rigid right-angled curved needle (right and left) (Fig. 248).



FIG. 248.—1. Rectangular knife for loosening edges which cannot be reached with an ordinary scalpel. 2. Curved needle on a rigid handle. These are in pairs, right and left. Instead of an eye a slot is an improvement, the needle being passed through, and the suture caught in the slot and pulled back with the needle.

Needle Holder.—Including one I invented myself I have yet to see a satisfactory needle holder for cleft palate work, and although there are a number of these on the market, I ordinarily use the Halsted hemostatic forceps for holding the needles, and find this as good as anything so far developed.

Suture Material.—I prefer very fine waxed silk for the uvula, horse-hair for the soft palate; horsehair, silkworm gut, or fine silver wire for the hard palate.

TECHNIC

Preparation of the Field.—After the patient has been anesthetized, the lips and surrounding tissues should be sponged with ether or benzine, followed by alcohol. Then, after the gag has been inserted, the operative field should be sponged with ether and painted with one-third strength tincture of iodine.

Operation.—After carefully trying most of the methods reported, I do not feel able to adopt any single technic for closing a cleft in the palate, but have collected what experience has shown me to be the

good points in several operations. The combination has proved most satisfactory.

In separating the mucoperiosteal flap from the hard palate I use the method described by Berry and Legg. A small incision is made down to the bone, either inside or outside of the posterior palatine artery

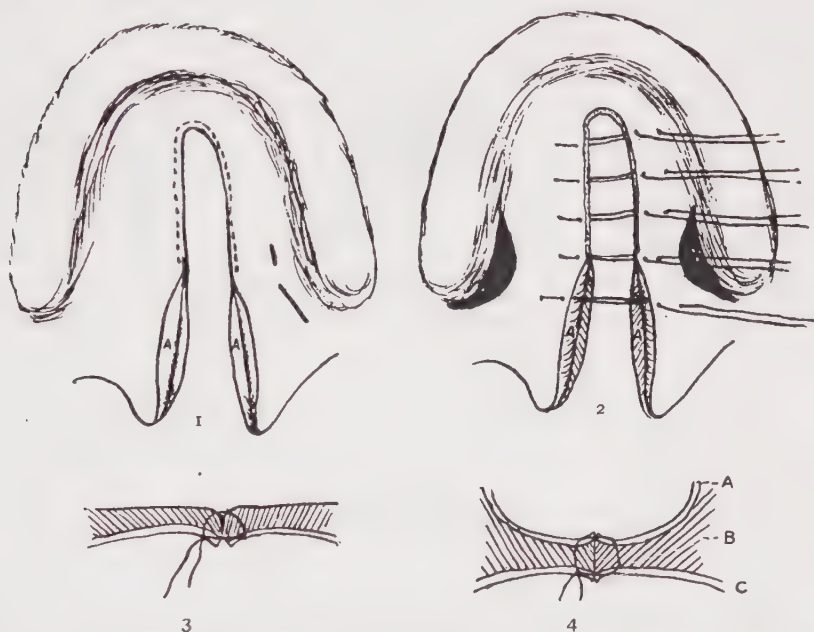


FIG. 249.—Method of closing an incomplete cleft of the hard palate associated with a complete cleft of the soft palate.—1. The short dark line near the alveolar margin shows the puncture wound through which the mucoperiosteal flap is detached from the hard palate. This incision may be lengthened if necessary. This dark line below this shows the situation of the relaxation incision which may be joined to the upper incision. After the flaps have been separated on each side and the attachment of the soft palate to the hard palate divided, the margins of the mucoperiosteal flaps are trimmed as indicated by the dotted line and the margins of the soft palate split lengthways. 2. The on-end mattress sutures in place. These sutures may be used in both hard and soft palate as shown in 3, or the same suture can be used to evert both mucous borders in the soft palate, as shown in 4. 3. The on-end mattress suture evert the mucous edges (*Blair*). 4. The on-end mattress suture evert the mucous edges on the pharyngeal and oral surface. A, the mucous membrane of the pharyngeal surface. B, the tissues of the soft palate. C, the oral mucous membrane.

according to the situation in which subsequent relaxation incision should be made.

The bleeding, which is usually quite severe after the initial incision for the insertion of the elevator, is soon controlled by pressure. Sometimes the posterior palatine artery is nicked, and, when this occurs, it is better to divide the artery completely to allow it to retract. In many

ases the control of bleeding consumes much time and adds considerably to the length of the operation.

A long narrow elevator should be inserted through this small incision and the periosteum and overlying mucous membrane should be thoroughly separated from the hard palate, the separation extending from the posterior edge over as large an area as is required. The ele-

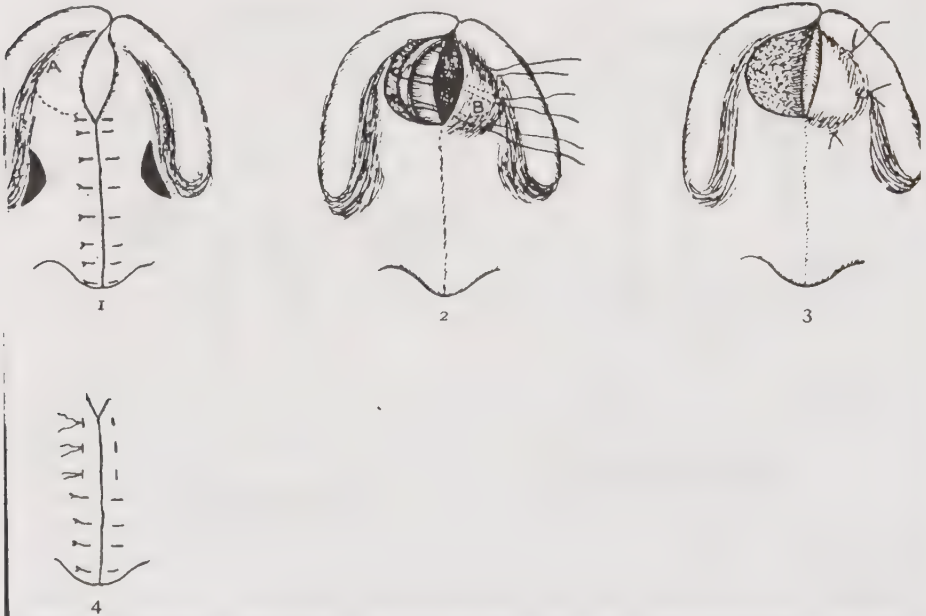


FIG. 250.—Method of closing a complete cleft of the hard and soft palates.—1 and 2. In some instances it is inadvisable to attempt the closure of the entire cleft at one operation. The posterior portion of the hard and the soft palate has been closed. A defect is left just behind the alveolar margin. This defect is usually best closed by a small flap with a pedicle at the margin of the cleft. The dotted line shows the outline of the flap A, raised from the widest side. An incision is made along the margin of the cleft on the opposite side and the mucoperiosteal flap B is undermined. The flap A is then turned over and its free edge is drawn well under B by properly placed sutures. 3. Shows the flap in place and the sutures tied. The raw surface from which the flap A was raised is allowed to anulate. The junction of the intermaxillary bone with the superior maxilla may be made this time by freshening and trying to make a bony union, or this may be postponed. 4. Shows another method of suturing. Using the ordinary mattress sutures in the mucoperiosteal flap and the on-end mattress suture in the soft palate.

levator is then forced through the margin of the cleft and separates it. A similar procedure is carried out on the other side. Then, with a pair of curved scissors, the soft palate is cut away from its attachment to the hard palate on each side. This is a most important step, and must be thoroughly done if the flaps are to be brought together in the midline without tension. It is important that the tissues at the junction of the hard and soft palate be kept as thick as possible in order

to avoid subsequent perforation, due to sloughing which often occurs at this point.

The margins of the mucoperiosteal flaps should then be pared, but the soft palate should be split in the manner described by Davies-Colley and H. M. Sherman, which saves loss of tissue and gives a broad surface for suture. The soft palate is then closed, beginning at its junction with the hard palate, and then the uvula. I prefer the over-end mattress suture for the soft palate throughout as used by Blair. The hard palate is then sutured with the same stitch.

I have often made the mistake of *inserting too many sutures*, and have found that these cases almost invariably do badly. Use only enough sutures to approximate the edges thoroughly, and do not put in an unnecessary stitch. It is always a temptation to make the line of closure perfect in appearance, but experience has shown me that those cases with only the absolutely necessary sutures do best.

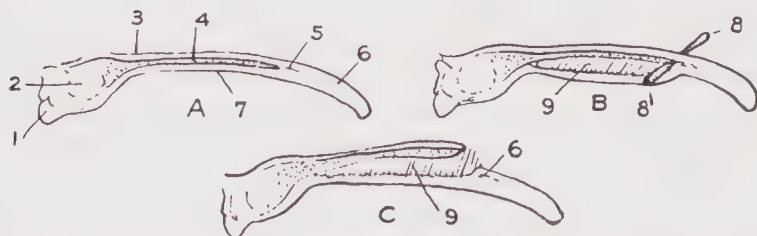


FIG. 251.—Method of separating the soft palate from the posterior edge of the hard palate (*Berry and Legg*).—Sagittal semi-diagrammatic section through the palate of infant. 1. Temporary incisor tooth. 2. Permanent incisor. 3. Mucous membrane floor of nostril. 4. Bony palate. 5. Aponeurosis of soft palate. 6. Soft palate. Mucoperiosteum of the hard palate. 8. Blades of a pair of scissors. 9. Space formed by detachment of mucoperiosteal flap. A. Parts before operation. B. Mucoperiosteal flap detached from hard palate. The soft palate remains attached. Blades of scissors inserted. C. After division of the aponeurosis and nasal mucous membrane.

It is often unwise to do a complete operation at one time. Sometimes it is safer to close the soft palate and the posterior portion of the hard palate first, and complete the repair of the anterior portion subsequently. The closure of the anterior portion of the hard palate is especially difficult, as there is little chance of mobilizing flaps by the edge-to-edge principle. In this situation it is best to raise a flap after the Lane method from the wider side and to insert it into a pocket on the narrower side, as has been recommended by Sherman and others. Lane's procedure is a particularly valuable method for closing defects in this region.

Relaxation incisions should be avoided if possible, and in some cases are not necessary. Nevertheless, it is better to make them

han to have any tension on the sutures. If the beginner should make he relaxation incisions as illustrated in many text-books, his flaps would ough from defective blood supply.

I have found the best incision for the majority of cases to be that escribed by Berry and Legg. It begins "a little in front of the junction f the hard and soft palates, near the alveolus, but internal to the osterior palatine foramen; it should extend obliquely backward to a oint nearly halfway between the posterior end of the alveolus, and the osterior margin of the soft palate." This incision should pierce the oft palate.

In some severe cases this incision must be prolonged, and others not idangering the blood supply made in order to give necessary relaxation.

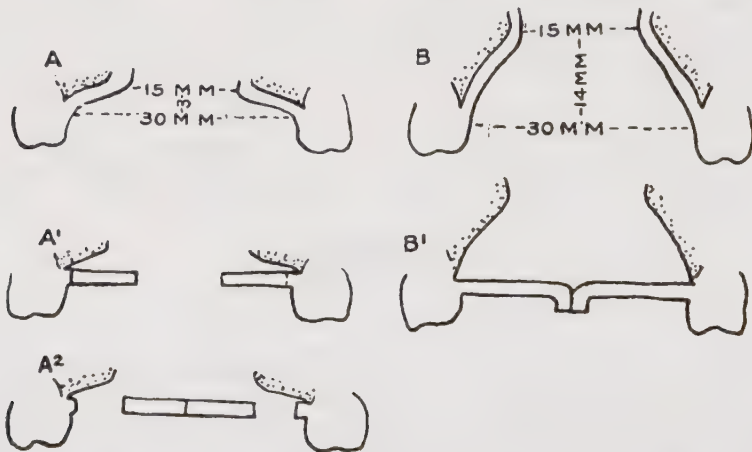


FIG. 252.—Diagrams showing the difference in the heights of the palatine arch, and illustrating the point that the higher the arch the more easily is closure made (*Berry and Legg*).—The clefts in A and B are of exactly the same width. In A' where the arch is low the detached mucoperiosteal flaps do not meet in the midline. In B' where the arch is high, the detached mucoperiosteal flaps meet easily in the midline. In A² with the low arch, the approximation is made possible by lateral liberating incisions.

I have tried the various methods of using paraffined tapes, lead and metal plates, and the like, to reinforce the palate sutures, but find them unnecessary in the ordinary cases if tension on the sutured flaps has been properly relieved.

The Two-stage Edge-to-edge Method.—In certain cases where the cleft is especially wide, or where the soft tissues are thin, it is advisable to do the edge-to-edge operation in two stages. The mucoperiosteal flaps are raised through lateral incisions without breaking through the cleft margins, and then after the soft palate has been separated from its attachment to the hard palate, the spaces between

the bone and flap are packed with iodoform gauze. By this mean the flaps are thickened, the blood supply is made more sure, and there is also stretching of the tissues. After four or five days the ordinary edge-to-edge closure is carried out. This is a very valuable procedure and by its use a cleft can be closed which would otherwise be hopeless.

Post-operative Care.—The same precautions should be exercised as have already been mentioned under Harelip. In addition to continuous instillation of water by the rectum, a subcutaneous infusion of normal salt solution is advisable whenever a considerable amount of blood has been lost. Sterile water should be given for the first 12 hours, and then sterile liquids, water being given after each feeding. Very soft diet may be allowed after one week, and after two weeks there may be a gradual increase, care being taken for several weeks to avoid lumpy food. Every effort should be made to keep the mouth clean with swabs, sprays or irrigations.

Older children may be allowed to get up after the shock of the operation has passed. Talking should not be allowed for at least a week.

There is little advantage gained by daily inspection of the wound, as nothing can be done at this period even if the stitches do not hold. In older children one is usually able to remove the deep stitches without an anesthetic, but for very young patients primary anesthesia is often necessary. I prefer to allow the deep stitches to remain for two weeks. If the edges have not united by that time there is little hope of union.

Complications in Cleft Palate

VOMITING which is long continued may be a serious complication, but fortunately this is usually temporary, lasting only a few hours. When it is a symptom of acidosis, it is always a serious matter.

A *temperature* of 100° to 103°F. is not uncommon in young children within the first 24 hours, and should give little uneasiness if it subsides within 48 hours. It may be due to the absorption of the swallowed blood, the bruising of the tissues, or to the prolonged operation.

Occasionally a child will develop a high temperature a few days after operation, and in these cases, after everything else has been eliminated, one must bear in mind middle-ear infection.

BRONCHITIS and BRONCHOPNEUMONIA are complications that are not infrequent and are sometimes fatal.

SLOUGH OF THE FLAPS.—At times death of the flap occurs due either to poor circulation or strangulation of the tissues by tight

drawn sutures. I have seen flaps in which the circulation was apparently good, melt away under an infection over which we had no control.

HEMORRHAGE.—In certain cases oozing continues for some time after operation, and if this keeps up it may become serious. Digital pressure usually is sufficient to control it, but this may cause a sloughing of all the tissues, or separation of the margins. At times it may be necessary to remove stitches and pack with gauze. So far I have been fortunate enough not to have had a case of secondary hemorrhage, (except in one hemophiliac), but such accidents have been reported.

There are two other methods of treating cleft palate, the principles of which are radically different from that already described. (1) **Forcible approximation of the sides of the cleft within three months after birth, preferably within a few hours.**

(2) **The turnover flap method.**

1. **Forcible approximation of the edges** is accomplished in two ways:

A. **BY CLAMPS**, which bite into the outer side of the upper gums and which are tightened every few days. These are allowed to remain in the mouth for several weeks. Hammond, Roberts, and Ulrich have designed clamps for this purpose. In my opinion they should never be employed.

B. **BY WIRING**; Brophy and Blair are the principal exponents of this method, and in their hands the results seem good.

I have never felt justified in performing this operation. It is certainly dangerous because of liability of extensive sloughing, and the results in the cases I have seen operated on by other surgeons have been far from satisfactory.

The principle of the operation, in brief, is to pass a silver wire through both superior maxillæ from a point just back of the malar processes, high enough to be above the palate. One or two other wires are also inserted at the same level behind the first one. The wires are passed through holes in lead plates molded to fit the contour of the bones, and these lie between the cheek and the bone. After the edges of the cleft have been freshened throughout, the margins are pressed together with the thumbs until they are approximated, and the wires are twisted so that the bones are held together. The soft palate may or may not be closed at this time. The plates and wires are allowed to remain in place about four weeks.

Much can be done toward narrowing the cleft by an orthodontic apparatus applied on the inside of the mouth, consisting of a nut and

screw bar, and bands for the teeth. Dr. G. V. I. Brown of Milwaukee has been able to accomplish a good deal with it in children as young as 18 months. This apparatus can also be applied to older children with success.

2. The Turnover Flap Method.—The Davies-Colley method was the first devised, and was recommended in those cases in which the

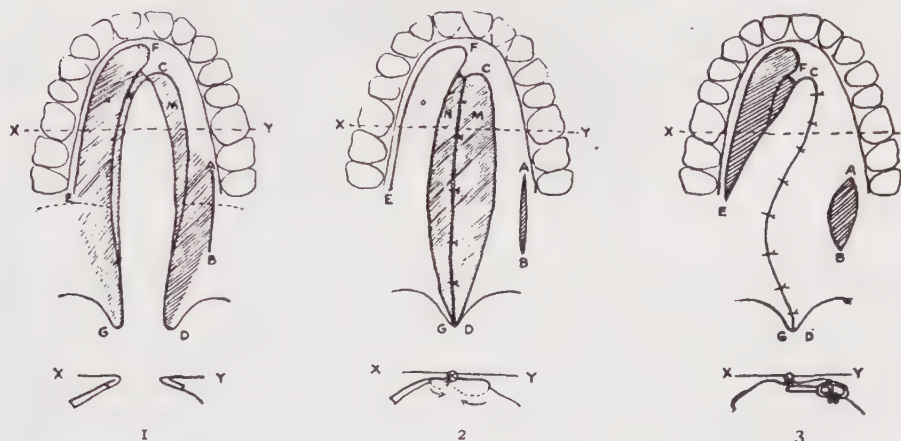


FIG. 253.—The flap method of closing a cleft palate (Davies-Colley).—1. The incision AB with its center just internal to the last molar tooth is made down to the bone in front and through the soft palate behind. Through this incision the mucoperiosteal flap is separated from the posterior half of the hard palate. The incision CD from just in front of the cleft and 0.625 cm. ($\frac{1}{4}$ inch) from its margin, is carried backward, gradually approaching the junction of the hard and soft palate; the tissues are loosened and turned inward. The incision should be continued along the cleft edge of the soft palate in such a way as to split that structure lengthwise. The flap EFG, which consists of mucoperiosteum, is raised by the incision EF, which runs parallel to and 0.4 cm. ($\frac{1}{6}$ inch) from the insertion of the last molar tooth to the median incisor. The incision FG runs backward 0.4 cm. ($\frac{1}{6}$ inch) from the margin of the cleft of the hard palate, and is continuous with the split in the soft palate, as on the other side. The shaded portion on the hard palate indicates the area in which the periosteum is separated, and on the soft palate the depth to which the tissues are split. The tissue internal to the line FG should be loosened and turned inward. The insert represents a transverse vertical section along the line X-Y. 2. The margins of the flaps M and N, and the upper plane of the soft palate are sutured together. The insert indicates the method of turning and suturing. 3. The mucoperiosteal flap O is then shifted over the sutured line and secured, and the lower plane of the soft palate is sutured.

defect was too wide for the edge-to-edge closure. The diagrams will fully explain the principle (Fig. 253).

Lane's method is based on the Davies-Colley method. Lane raises a flap of mucoperiosteum from one side, with its base close to the margin of the cleft. Then on the opposite side the mucoperiosteal flap is undermined through an incision along the margin of the cleft. The free edge of the flap from the opposite side is then drawn into this pocket and is held by sutures (Figs. 254-260).

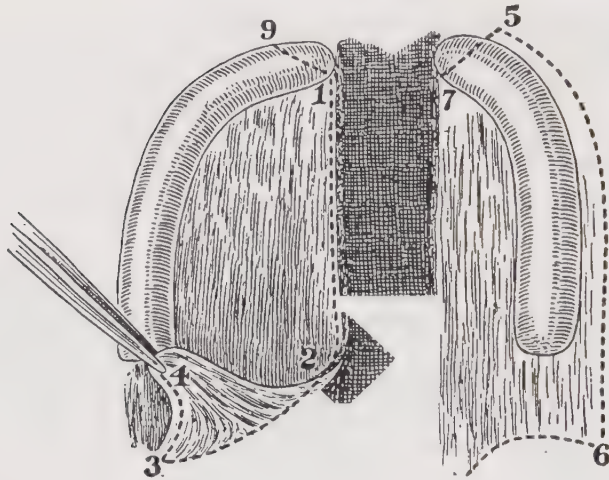


FIG. 254.—Lane's operation for complete unilateral cleft palate (*Binnie*).—Reflect the flap outlined by the dotted line 7, 5, 6, 8. Make the incision through the mucoperiosteum of the bone on the hard palate, but only through the submucosa in the soft palate. The incision 5 to 6 is made on the outer surface of the alveolus near the reflection of the mucosa to the cheek. When the flap is raised the posterior palatine vessels are caught and clamped. On the side of the cleft attached to the septum pull the uvula and soft palate forward to expose the nasal surface. Divide the posterior external edge of the soft palate 4, 3, through the submucosa and extend this incision along the nasal surface of the hard and soft palate to the cleft 3, 2. The incision down to the bone is continued along the cleft 2, 1, and across the alveolus margin 1, 9.

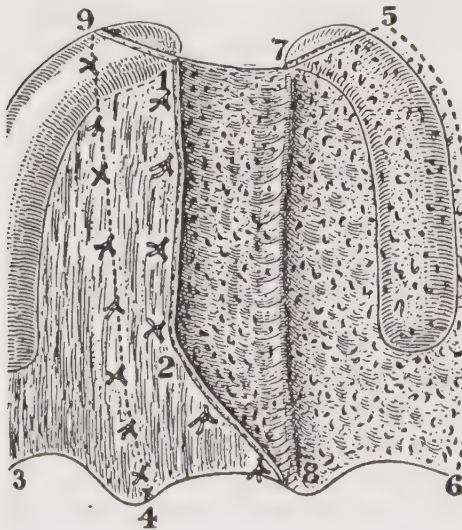


FIG. 255.

Lane's operation, *continued* (*Binnie*).

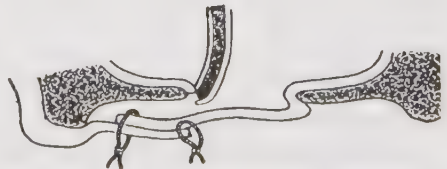


FIG. 256.

FIG. 255.—Reflect the mucous flap 4, 3, 2, and separate the mucoperiosteal flap from the bone through the incision 2, 1, 9. Then divide the attachment of the soft to the hard palate in the usual way. Turn over the flap 7, 5, 6, 8, so that its mucous surface is toward the nose and its raw surface toward the mouth. Draw the free edge of the flap 7, 5, 6, 9, under the flap 9, 1, 2, 3, 4, and suture it into position as indicated.

FIG. 256.—Indicates the position of the flaps after they are sutured.

the secondary operation, following a complete failure, as soon as the edges are healthy, or in about three or four weeks. My own preference is to wait for a longer period until healing is complete.

In partial failure the chances of success are much greater, but a considerable period should elapse before the secondary operation. I have been astonished at the amount of spontaneous closure of defects in the suture line which at first seemed to call for an extensive secondary

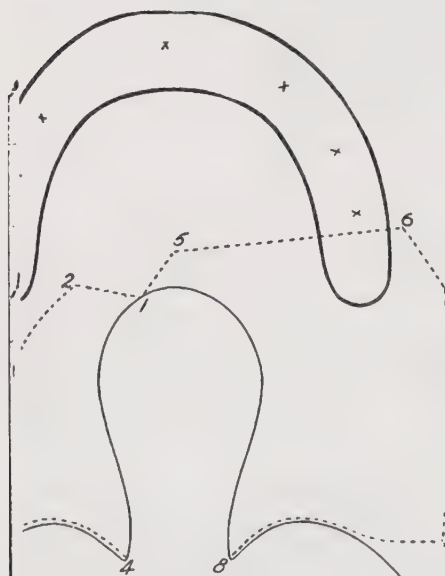


FIG. 259.

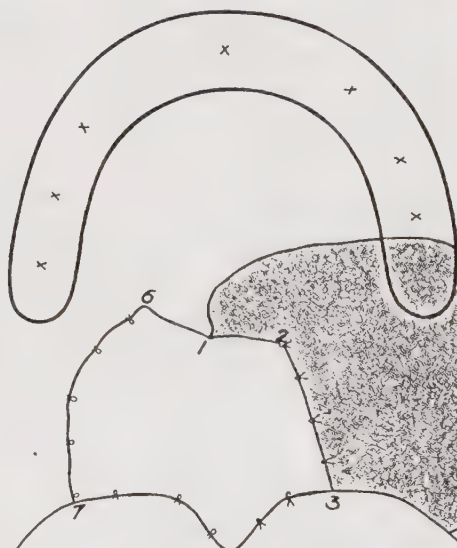


FIG. 260.

Lane's operation for wide cleft of the soft palate (*Binnie*).

FIG. 259.—The dotted line 1, 5, 6, 7, 8, indicates the outline of the flap of mucoperiosteum which is raised and frees the hard palate and mucosa from the soft palate and cheek. From the nasal surface of the soft palate on the opposite side the flap 1, 2, 3, 4, is raised. The bases of these flaps are at the edge of the cleft.

FIG. 260.—The flap 1, 5, 6, 7, 8, is turned over with mucous surface inward toward the nasal cavity. The flap 1, 2, 3, 4, is turned outward with its mucous surface toward the mouth. They are over-lapped and sutured in position. Care must be taken not to injure the musculature of the soft palate in raising these flaps.

operation. It is useless to attempt to close a defect of any size in the hard palate by simply freshening the edges and suturing. Extensive undermining and lateral relaxation incisions are necessary. Defects in the anterior portion of the hard palate are best closed with pedunculated flaps shaped in the way best suited for the special case.

Holes in the hard palate due to syphilis, tuberculosis, typhoid ulceration, or injury, are treated in a similar manner.

Hett found the inferior turbinates of great use in repairing wounds

causing hard palate perforations. These bones may also be employed in closing certain resistant palate perforations in which there is much scar, and only a small amount of tissue available. The bone is partially severed from its attachment, is pushed down and used, after freshening the edges, as a sort of pedunculated flap to plug the opening, the pedicle

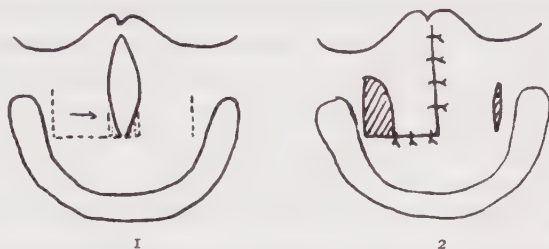


FIG. 261.—Operation for closing a partial cleft of the hard and soft palates (*Schoumaker*).—1. The dotted lines indicate the incisions. The margins of the cleft are either denuded or split. 2. The flap is shifted toward the midline and sutured.

being severed later (Fig. 262). Defects in the soft palate can usually be closed by freshening the edges and suturing, although if much scar tissue is present, lateral relaxation incisions are necessary. Sometimes lateral pedunculated flaps may be shifted in to good advantage.

It is necessary in some cases to operate six or eight times before the defects are completely closed.

Transplantation of Extrapalatal Tissue to Close Palate Defects.—There are certain cases which have lost (through sloughing following previous operative procedures) practically all of the soft tissue usually employed for closure of the cleft. These defects can be closed by using tissues obtained from the buccal mucous membrane, as described by Blair, and also by means of pedunculated flaps of tissue from inside the lip and cheek, or from the skin of the neck (Fig. 263).



FIG. 262.—Method of using the anterior and posterior ends of the inferior turbinates to fill up traumatic perforations in the floor of the nose (*Hell*).

The flap from the neck is inserted through an opening made between the cheek and jaw bone, in much the same manner as in lining a cheek defect. It might be advantageous to use Thiersch grafts on the raw surface of the flap to prevent subsequent contracture, and then after the graft has taken, to suture the flap with the epithelium on both sides into the palate defect. It is, of course, necessary that all scar

tissue be removed from the edges of the defect, before suturing in the flap with silkworm gut or horsehair. The jaws should be held apart, in the pedunculated flap operations (to prevent interference with the blood supply) with a block wired to the teeth until the pedicle is cut. The pedicle should be divided in from ten to fourteen days, after which the rest of the opening is closed, the base of the flap being turned out again and utilized for filling the upper portion of the neck defect.

After proper closure of the lip and palate, by whatever method, the child should be placed in the hands of a competent dental surgeon who should take charge of straightening the teeth and adjusting the line of the jaws by proper orthodontic measures.

Obturers.—The great majority of cleft palate cases should be treated by operation. Up to a short time ago I would have said all cases, but recently I have seen a “bleeder” with very scant tissue in

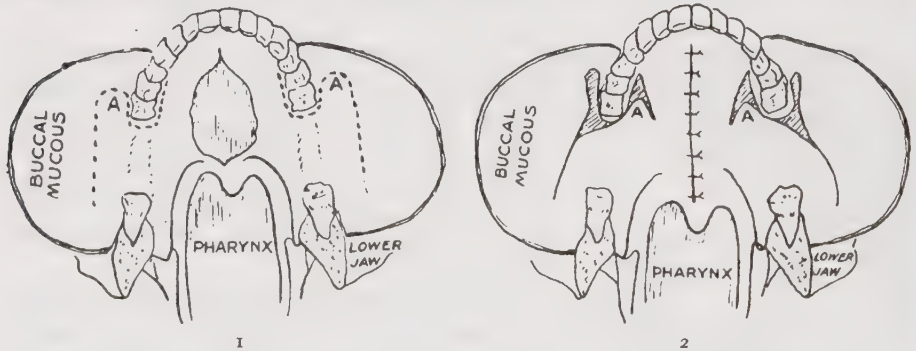


FIG. 263.—The repair of a palate defect by means of mucosa from the cheek (*Blair*).—
 1. The dotted lines indicate the incisions made to raise the flap of mucoperiosteum from the hard palate and mucosa and buccinator muscle from the cheek. 2. The flap A is shifted inside the alveolar margin on each side. It may be necessary to fracture the hamular process on each side and extensive undercutting may be required. I have not been very favorably impressed with this method.

which there was no possible chance of operative success, and in this case I advised the use of an obturator.

In some old cases which have been the rounds it is useless to try further operative work. Then an obturator offers the best solution to the problem.

In my opinion obturators should be used only in those cases in which operative procedures have been exhausted, or in those which from their nature preclude operative interference.

Fairly good speech is possible following the use of obturators covering defects in the hard palate, if the soft palate is reasonably pliable. Obturators to which artificial vela are attached are seldom satisfactory from the speech standpoint, although Mitchell reports successful cases.

It is impracticable to use obturators on growing children, but later they may be very useful in some cases.

Training in Articulation.—Special attention should be given to speech training, and if this is carefully done, by the parents or by professional teachers, good results will be obtained. The child should be taught to speak slowly, to pronounce every syllable, and to give full value to every consonant sound. Details of the method may be found in works on Oral Surgery.

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CHAPTER XII

EXSTROPHY OF THE BLADDER (ECTOPIA VESICÆ).

This distressing condition is caused by the maldevelopment of the structures which make up the anterior wall of the bladder, and the corresponding portion of the abdominal wall. The posterior wall of the bladder protrudes much like a rosette, and on the lower portion of this mucous surface the urine is constantly being discharged from the exposed ureteral orifices. Associated with this condition unilateral pubic bones and epispadias are found. Occasionally double inguinal hernia is present.

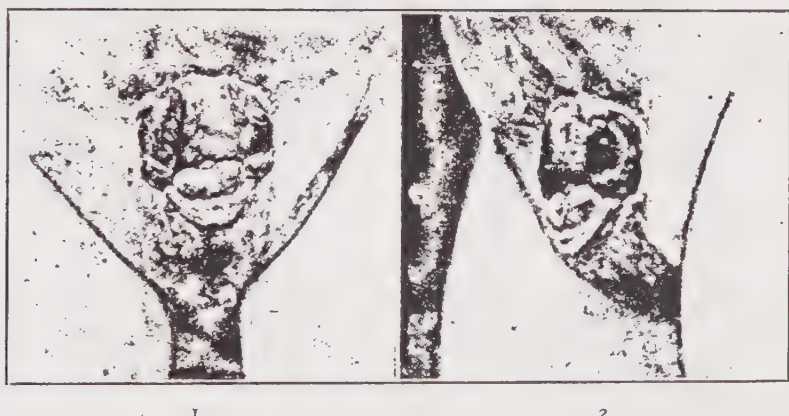


FIG. 264.—Complete exstrophy of the bladder with epispadias.—This patient was subsequently cured by transplanting the ureters with a rosette of mucous membrane into the rectum.

Exstrophy of the bladder is rare, occurring only once in from 30,000 to 50,000 births. It occurs much more frequently in males.

Berger says that of 74 patients not operated upon, born with exstrophy of the bladder, only 23 passed their 20th year, 68 per cent dying of pyelonephritis.

TIME OF OPERATION.—Children should be at least four or five years of age. Good physical condition is essential for such a serious operation.

THREE GENERAL GROUPS of operative procedures have been devised for the correction of this deformity.

(A) THOSE WHOSE OBJECT IS THE PLASTIC RECONSTRUCTION OF A BLADDER.—(1) By the formation of the anterior wall from pedunculated flaps of adjacent skin. (Roux, 1852, Nélaton, Thiersch, Wood, and others.) Wood's method of forming the skin flaps from the abdominal wall is that most commonly used, and the diagram is self-explanatory (Fig. 265).

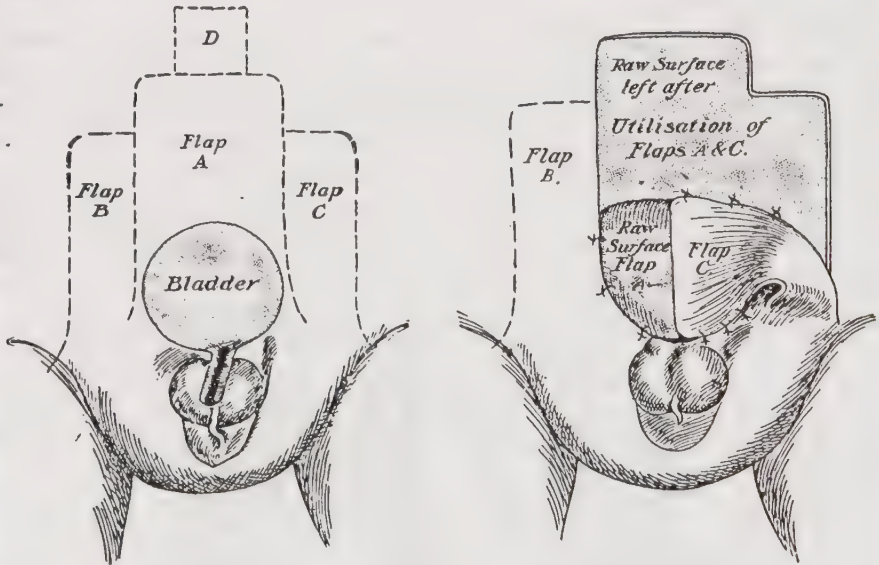


FIG. 265.—Wood's operation for exstrophy of the bladder (Binnie).—1. The flap A is made of the abdominal skin with its pedicle about .625 cm. ($\frac{1}{4}$ inch) from the edge of the bladder. Its size should be planned to allow for shrinkage. If it is desired to cover the dorsum of the penis with the same flap AD should be raised. Flaps B and C are obtained from the skin of the abdominal wall external to the bladder and flap A, and are raised or covering flap A after it is turned down and sutured. 2. The flap A has been turned down, epithelial surface inward, and sutured to the freshened edges of the bladder. Flap C is raised and shifted inward as is flap B, and their free ends are sutured together to cover flap A. The raw surface is made smaller by drawing in the surrounding skin and the rest of skin grafted. If the extension D of flap A is used, it is sutured to the freshened edges of the penile gutter. There are many modifications of this method which must be made to suit the individual case.

(2) By the use of an isolated loop of intestine. (Rutkowsky, 1899, and others.)

(3) By freshening and uniting the edges of the defective bladder, after bringing together the widely separated pubic bones. To accomplish this, Trendelenburg divides the sacroiliac synchondrosis on each side. König, Koch, and others secure the same result by division or fracture of the horizontal and descending rami of the pubes, followed by suture of the loosened margins of the bladder. Passavant uses an orthopedic pressure apparatus to bring the bones together.

(4) Schlange mobilizes the lower end of each rectus muscle, chise away the bony insertions, and slides them toward the midline, when they are secured. The edges of the bladder are then united.

(5) The bladder is formed by isolating a loop of intestine. The continuity of the bowel is reestablished and the lower end of the loop is brought down between the rectum and the anal sphincter. The ureters are implanted in the upper end of the loop. (Gersuny, 1898

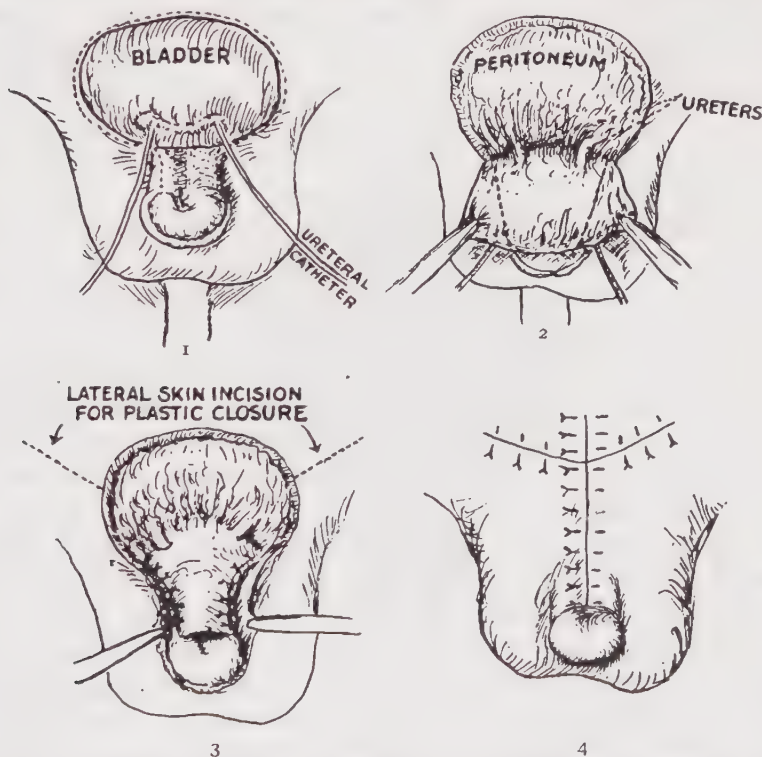


FIG. 266.—Segond's operation for extrophy of the bladder (Kanavel).—1. Shows the condition before operation. The dotted line indicates the incision around the bladder and on the penis. 2. The bladder turned down over the penis. The dotted lines indicate the incisions for the removal of the excess bladder wall. 3. The bladder wall sutured to the epispadiac mucous membrane. 4. Skin closed over penile and abdominal defects.

(6) The bladder is formed from the isolated lower end of the cecum, the appendix being brought through the abdominal wall as in an appendicostomy, and the urine being removed through a catheter. (Makins, 1910.)

(B) THOSE WHOSE OBJECT IS THE DIVERSION OF THE URINARY STREAM: TO THE URETHRA, VAGINA, OR SKIN SURFACE.—(1) The implantation of the ureters into the urethral groove, and closing of the gutter. (Sonnenberg, 1885, Segond, and others.) (Fig. 266.)

(2) Implantation of the ureters into the vagina. (Pawlic, 1891, havasse, and others.)

(3) Transplantation of the ureters into the skin surface of the loin. (Harrison, 1896, Bottomley, and others.)

(C) THOSE WHOSE OBJECT IS THE DIVERSION OF THE URINARY STREAM INTO THE RECTUM.—(1) The implantation (intraperitoneally) of the trigone of the bladder, with the ureteral orifices intact, into the wall of the sigmoid rectum. (Maydl, 1892, Lendon, Peters, Moynihan, H. Mayo, W. D. Haggard, and many others.)

These operations are also done extraperitoneally. Instead of the trigone only, the whole bladder has been implanted.

(2) The ureters with a rosette of bladder attached have been implanted into separate incisions in the rectum by the extraperitoneal route. (Bergenheim, 1894, Peters and others.)

(3) Implantation of the ureters alone into the intestine. (Simon, 1846, Lloyd, Fowler, Smith, C. H. Mayo, and others.)

The above is a brief outline of some of the many operative procedures which have been practised for this deformity.

To my mind only three methods promise results which will be acceptable to the patient, and I shall describe in brief the technic which seems to me most desirable in each of these methods. On these, as a basis, the operator can introduce the modifications called for by the peculiarities of individual cases.

The Transplantation of the Ureters into the Skin of the Loin.
Bottomley's Operation. FIRST STEP.—A 10 cm. (4-inch) incision is made following in a general way the crest of the ilium, about 2.5 cm. (1 inch) above and to its inner side. The external oblique aponeurosis and muscle is split in the direction of its fibers; the deeper muscular layers are divided sufficiently to allow the peritoneum to be pushed forward; the ureter is located and freed by blunt dissection for several inches of its length, and is divided where it crosses the iliac vessels. The distal end is ligatured, and through a small incision in the loin the proximal end is brought to the surface and sutured to the skin with chromic gutgut stitches, which do not penetrate the mucosa. The end of the ureter, which should project about 0.312 cm. ($\frac{1}{8}$ inch), is split and the flaps are turned outward and sutured. The abdominal wound is closed in layers. Both sides are done in this way.

SECOND STEP.—Two weeks later the vesical mucous membrane and distal portions of the ureters are removed, and the defect is closed with a skin and fat flap, shifted in from the abdominal wall. Following

this operation the patient must, of course, wear some apparatus held in place with a belt, for collecting the urine.

The operation is simple and comparatively safe. There is probably less danger of renal infection than in the other methods to be described. The disadvantage is the necessity of wearing a collecting apparatus but this can be easily fitted over the fistulæ in the back, and with proper care the urinary odors can be avoided.

Transplantation of the Bladder into the Rectum (Extraperitoneally). Moynihan-Maydl Operation.—A catheter is passed for 10 cm. (4 inches) into each ureter, and is fixed there with a single stitch. An incision is made at the junction of the mucosa and the skin a

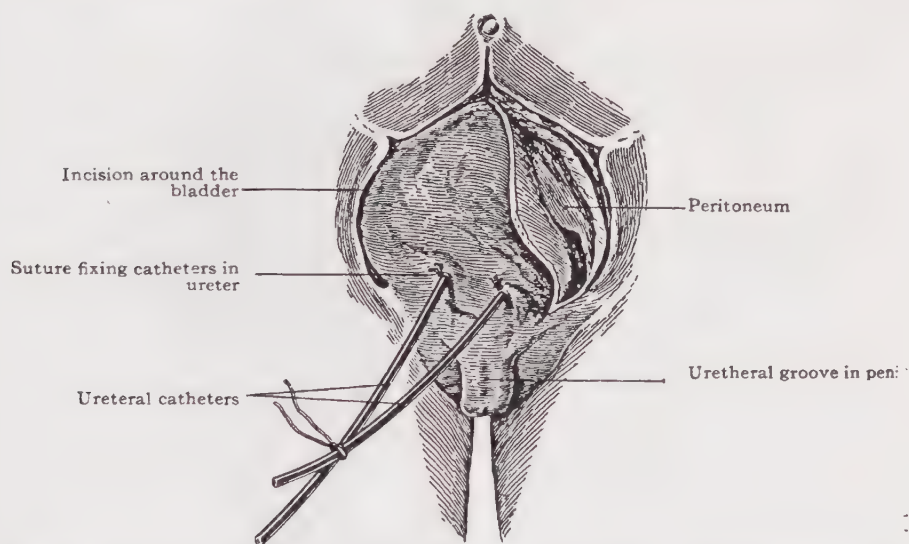


FIG. 267.—Moynihan's operation for exstrophy of the bladder (Jacobson).—The bladder is liberated without opening the peritoneum.

around the bladder, which is gradually raised by careful dissection until it is isolated, leaving only as its pedicle, so to speak, the two ureters. As much tissue is left around each ureter as possible, so as to avoid the possibility of damage either to the ureter itself, or to its vessels.

As soon as the bladder is well isolated it is drawn upward out of the way by an assistant. In the bottom of the wound the rectum with peritoneal reflection is now seen. The peritoneum is then stripped upward from the front of the rectum until 10. or 12.5 cm. (4 or 5 inches) of the bowel are exposed. The finger of an assistant having been passed into the rectum to make it prominent, traction sutures are placed a

An incision 8.75 cm. ($3\frac{1}{2}$ inches) in length is made along the anterior surface of the bowel. Into this opening the bladder is placed, being turned upside down so that its former anterior surface becomes posterior, and its former lower end becomes the upper. The ureters instead of passing forward to the bladder pass backward, and the catheters pass to the rectum and out at the anus, the sphincter having previously

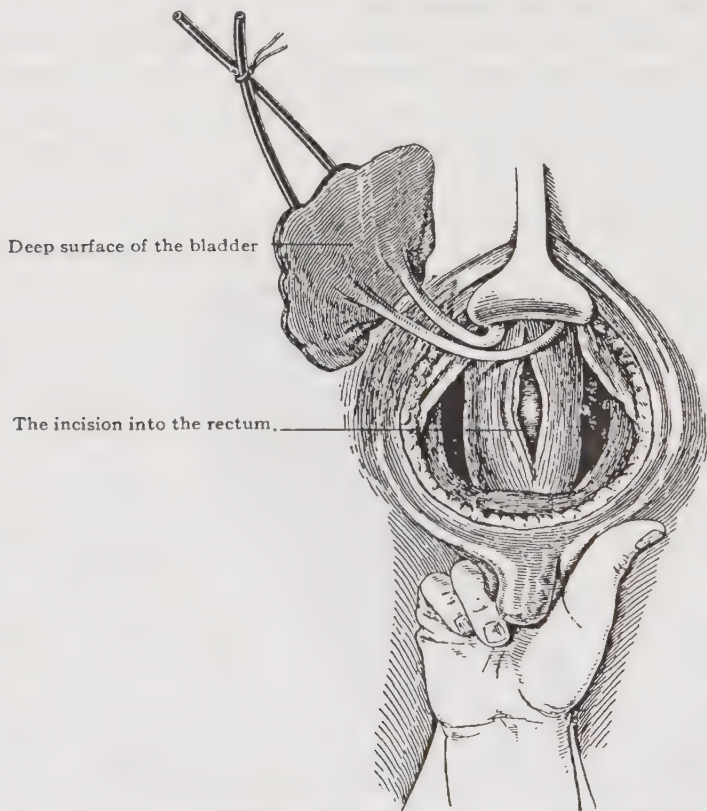


FIG. 268.—Moynihan's operation for exstrophy of the bladder, *continued* (Jacobson).—The ureters should not be stripped as freely as shown, as the blood supply must be preserved.

been dilated. The edge of the bladder and the cut edges of the rectum are sutured together with a continuous suture on each side for the mucous membrane, and any appropriate infolding intestinal suture for the outside. A few additional sutures may be inserted when necessary. In the Maydl operation the trigone is implanted into the rectum intraperitoneally (Figs. 267-269).

The Bergenhem-Peters operation is done extraperitoneally, and the procedure is practically identical with the Moynihan operation just

described, except that each ureter with a rosette of bladder tissue surrounding the orifice is separately implanted on opposite sides of the rectum. Both ureters may be implanted at the same operation, or one at a time.

The Implantation of the Free Ureters into the Sigmoid. C. Mayo's Operation.—According to Mayo the secret of successful anastomosing the ureter into the bowel is to tubularize the ureteral entrance for 3.125 cm. ($1\frac{1}{4}$ inches). His operation is based on Coffey's modification of Witzel's gastrostomy operation and is carried out

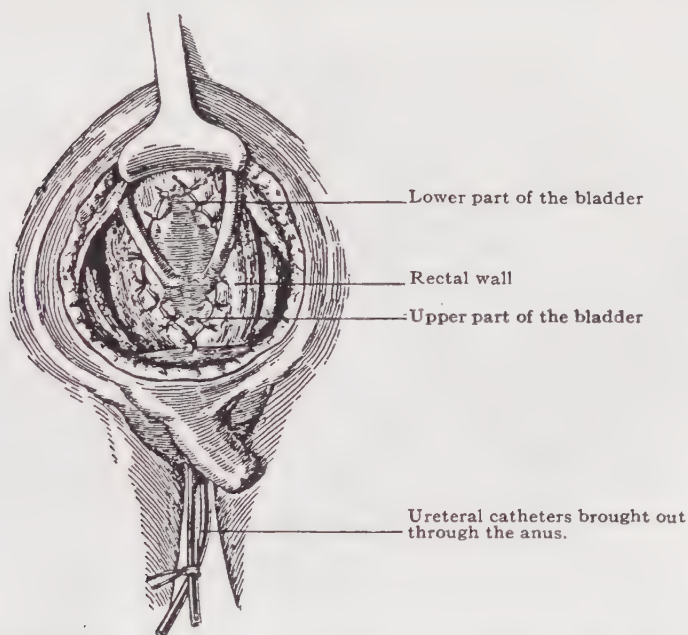


FIG. 269.—Moynihan's operation for exstrophy of the bladder, *continued* (Jacobson). The bladder has been rotated so that its upper end can be sutured to the lower part of the incision in the rectum. The ureteral catheters are brought out through the anus.

as follows: A low lateral pelvic incision is made, preferably on the right side first, and the sigmoid is exposed. It naturally passes to the left and can always be found on this side, whereas if the incision is made on the left side first, the slack bowel may be difficult to find. The peritoneum and muscularis, in a longitudinal band, are incised longitudinally for about 3.125 to 3.75 cm. ($1\frac{1}{4}$ to $1\frac{1}{2}$ inches) down to the mucous membrane, but not through it. The ureter is exposed by an incision in the peritoneum in the posterior pelvic wall, and is isolated to within 2.5 or 3.75 cm. (1 or $1\frac{1}{2}$ inches) of the bladder, where it

divided and the distal end ligated. From 6.25 to 7.5 cm. ($2\frac{1}{2}$ to 3 inches) of the ureter are exposed, the posterior peritoneal incision is closed by suture to the point where it emerges. The lower end of the ureter is split for 0.625 cm. ($\frac{1}{4}$ inch), a curved needle with chromic catgut is passed through the end, the catgut is tied, and the short end of the thread is cut. A small perforation is made into the lumen of the bowel in the lower end of the incision through the mucous membrane, to prevent contamination of the wound. A large curved rubber-covered clamp is used to hold the bowel in position, and the union is made within the curve of the clamp. The curved needle carrying the catgut

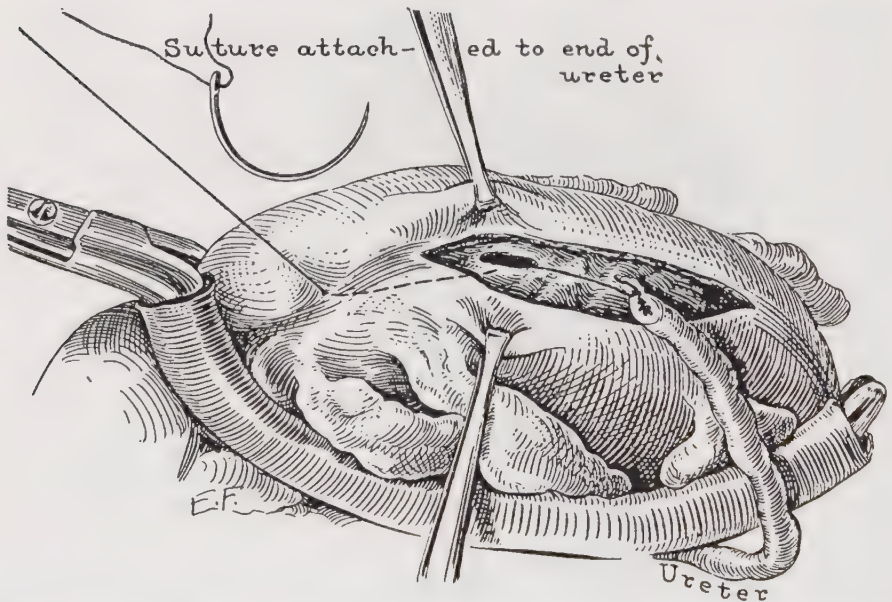


FIG. 270.—C. H. Mayo's operation for exstrophy of the bladder.—The ureter has been freed and longitudinal incision made in the wall of the sigmoid down to the mucosa. In the lower portion a small button-hole has been made and through this the catgut suture attached to the ureter has been passed coming through the bowel below.

attached to the end of the ureter is passed into the lumen of the bowel through the small opening, and out through the wall of the bowel 0.625 cm. ($\frac{1}{2}$ inch) below it. The drawing of the chromic catgut suture pulls the end of the ureter into the lumen of the bowel. The needle is then passed once through the peritoneum and muscularis, in order that the catgut may be tied to hold the ureter fixed within the wall of the intestine. The sides of the incision in the outer wall of the bowel are closed over the ureter, the needle including its outer tissue in two or three sutures. A second row of peritoneal sutures is placed over this,

extending down over the tied knot of the fixation suture which holds the ureter in place. This gives the ureter a natural duct entrance. The slightest pressure from within closes the duct, but not sufficiently to prevent delivery of urine by the automatic and intermittent waves of contraction occurring about six or eight times a minute during the period of activity (Fig. 270 and 271).

The intestine is held by a few sutures to the posterior peritoneum so as to cover the ureteral entrance. It is best to do but one side at the

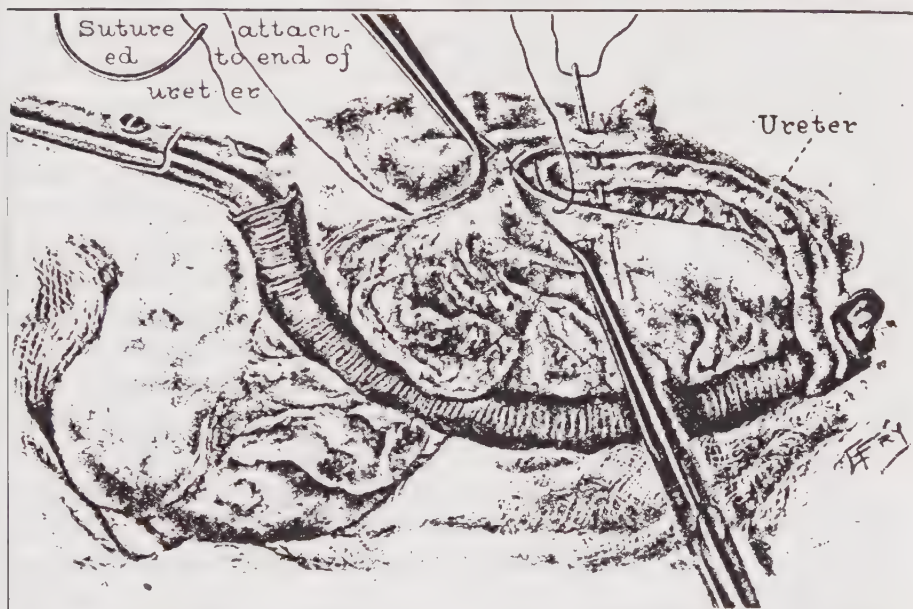


FIG. 271.—C. H. Mayo's operation for exstrophy of the bladder, *continued*. The ureter has been drawn down into the bowel and the bowel wall is being infolded over the ureter.

first operation, as the urine is absorbed from the large bowel like Murphy drip. Tolerance is soon acquired, however, and the slight uremic mental apathy disappears in a week. The second ureter may be transplanted with no trouble in from one to two weeks after the first operation. A small tube may be kept in the rectum for the first few days unless it adds to the discomfort. Usually at once, or at least within a few days, the urine will be passed at moderately frequent intervals.

Comments

In those operations whose object is to reconstruct a bladder, whatever the method used, the result, even if successful, is merely the fo

nation of a reservoir which, being without a sphincter, has not the power to retain the urine. These receptacles soon become infected and very foul, and infection may extend from them up the ureters.

Fistulæ occur where skin flaps are used, and urinary concretions form in the newly made bladder, whether it be lined with skin or with bowel mucous membrane. The only advantages of the method are that the bladder mucosa is protected, and therefore the condition is not so painful; and that a collecting apparatus can be attached more easily than before such an operation.

The plastic problems in these cases are fascinating, but the results do not justify the time taken and the multiple operations necessary.

The implantation of the ureters into the sigmoid-rectum, either with a portion of the bladder, or free, if properly done are quite worth while, and many good results have been obtained, especially since intestinal operative technic has been perfected. The immediate danger of uremia due to absorption of urine from the bowel and the later danger of ascending infection must be borne in mind; but when we take into consideration that the same danger (but possibly to a less degree) also confronts the non-operated case, and compare this with the comfort and satisfaction of the patient, who can lead for the first time a comparatively normal life, the risk is well worth taking. In time these patients can hold the urine as long as four or five hours.

A number of good results have been reported after implantation of the ureters into the back (by the Harrison-Bottomley method); and this is probably the operation of choice for patients over 40 years of age (Mayo).

Buchanan, in 1909, collected 98 cases of patients who had survived the intestinal implantation of intact ureters with a part of the bladder wall (Maydl and Bergenheim methods) and has tabulated the results as follows: eleven died of ascending renal infection (11.2 per cent); two died of preëxisting renal disease; seven died of causes other than renal disease; two died of causes unknown; one was reported with polyuria; eleven were not heard from after leaving the hospital; sixty-four were well at the last report; of these thirteen reported well within one year after operation; twenty-six were reported as well between one and three years after operation; ten were reported as well between three and six years after operation; fifteen were reported as well between six and twelve years after operation.

IMMEDIATE MORTALITY, MAYDL METHOD.—(Direct intraperitoneal implantation of the trigone, including both ureteral orifices, in the

wall of the rectum) 28.7 per cent. Of fifty-seven recoveries by this method 65 per cent lived one year and 24 per cent over five years.

IMMEDIATE MORTALITY, BERGENHEM METHOD.—(Independent extraperitoneal implantation of the ureters, each with a rosette of bladder wall into the rectum) 11.5 per cent.

Stevens, in 1916, added sixteen cases to Buchanan's Maydl group and found the total immediate mortality 28.1 per cent. Of the sixty-nine recoveries from operation 67.7 per cent lived over one year, and 26.1 per cent over five years.

To Buchanan's Bergenhem group, he added seven cases, and found the total immediate mortality 15 per cent. Of twenty-eight recoveries from operation 60.7 per cent lived over one year, and 21.4 per cent over five years.

It is striking that the immediate mortality following the Mayo operation (28.1 per cent) is greater than that following the Bergenhem operation (15 per cent). This is probably due to the intraperitoneal route usually employed in performing the Maydl operation, and the elimination of this risk (intraperitoneal route) in the Bergenhem operation. After recovery the ultimate results are about the same.

The Bergenhem method is simpler, and one ureter can be implanted at a time, thus avoiding possible uremia.

In C. H. Mayo's most recent paper he gives the results of operative treatment in 21 cases: six were done by the plastic method; none of these patients were able to control the urine; one died six months later of traumatic exstrophy at childbirth; three were submitted to re-implantation of the ureters and a portion of the bladder (Maydl-Moynihan method); two died in the hospital of uremia; thirteen were submitted to a transplantation of free ureters into the bowel of these one died in the hospital, one died from pneumonia several weeks after discharge, and two others died three years later from other causes.

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CHAPTER XIII

EPISPADIAS

Epispadias is a rare congenital deformity in which a portion or all of the roof of the urethra is absent, the canal being represented by a furrow occupying the mid-dorsal aspect of the penis. The penis is usually short and broad, and is curved upward. According to Baron epispadias occurs only twice to each three hundred cases of hypospadias.

TIME OF OPERATION.—The correction of this condition by operation should not be undertaken on children under six years of age.

TREATMENT

IN PREPARING THE SKIN for operations for epispadias and hypospadias, I prefer thorough scrubbing with soap and water with gauze

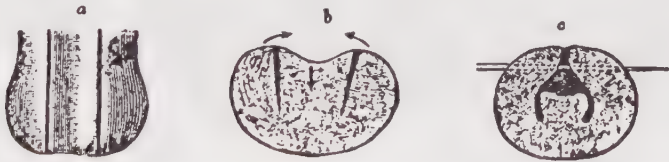


FIG. 272.—Thiersch's operation for epispadias (Binnie).—Method of constructing the glandular urethra.

not a brush—followed by ether. Iodin is too irritating to the skin of this region, and tends to cause trouble after operation.

In all of these operations the *hemorrhage* must be thoroughly checked. For dressings in both epispadias and hypospadias I use iodoform gauze wrapped snugly around the part. Should the tissues become edematous, the iodoform gauze may be saturated with glycerin.

PRELIMINARY STEPS.—(1) *The formation of a perineal fistula through which the bladder is drained during the operative procedure on the urethra.*

(2) THE STRAIGHTENING OF THE PENIS.—This is accomplished by dividing the corpora cavernosa close to the pubes, after which the penis is held down with a splint for several weeks. If the division of the corpora is not sufficient, more extensive dissection and excision of the contracted tissues must be carried out.

The classical operation of Thiersch for the relief of complete epispadias is as follows:

(1) **The Construction of a Urethra in the Glans Penis.**—Two deep incisions are made parallel to the urethral groove (Fig. 272, *A* and *B*). A glass rod is laid along the groove and the spongy tissue is pressed down. The lateral flaps are then sutured over the rod.

(2) **Construction of the Penile Urethra.**—After healing is complete in the glans, two quadrilateral flaps are raised along the whole length of the urethral groove, the flap *A* (Fig. 273) having its base next to the

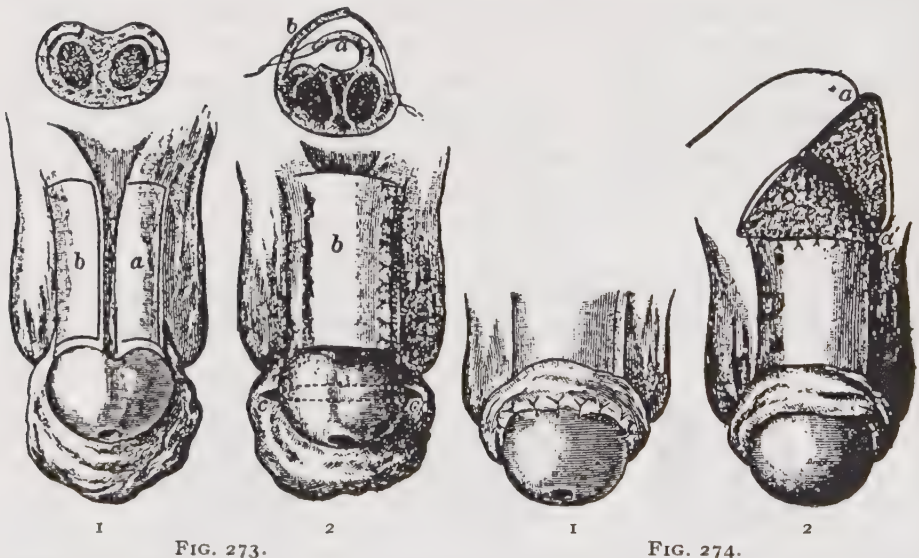


FIG. 273.

FIG. 274.

FIG. 273.—Thiersch's operation for epispadias, *continued* (Binnie).—1 and 2. Method of constructing the penile urethra.

FIG. 274.—Thiersch's operation for epispadias, *continued*.—1 and 2. Method of connecting the newly formed channel.

groove, and the flap *B* having its base away from the groove. The flap *A* is turned over (skin surface down), and is sutured under flap *B* near its base. Flap *B* is then shifted over flap *A* and its edge is sutured to the raw edge left on the skin of the penis when flap *A* was raised.

(3) **The Opening Between the Penile and Glandular Portions of the Urethra is Then Closed by Utilizing the Redundant Prepuce.**—A transverse incision *CC* is made through the prepuce near its base (Fig. 274, 1) and the glans is pushed through this opening, and the defect is closed by suturing the freshened edges of the penile and glandular urethra to the prepuce.

(4) **The Epispadial Opening Is Closed with a Pedunculated Flap from the Pubis.**—The new canal is united to the epispadial opening by

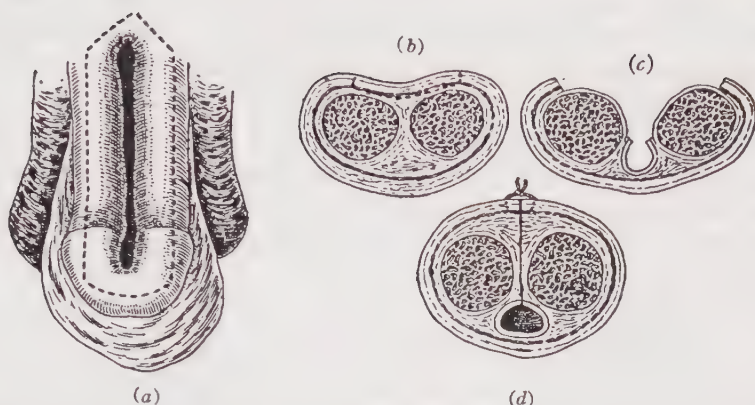


FIG. 275.—Cantwell's operation for epispadias (Binnie).—A. The dotted line indicates the incisions made at the mucocutaneous junction of the groove. The incision penetrate down to the corpora cavernosa. B. Separate the urethra as a pedunculated flap with its base above from its bed and hold it aside. C. Separate the corpora until the skin on the lower surface of the penis is reached. Then place the urethral flap against the skin in the bottom of the channel between the corpora and suture its edges over a rubber tube. D. Bring the corpora cavernosa together over the urethra, and close the wound. Before beginning the operation bladder drainage should be established through the perineum.

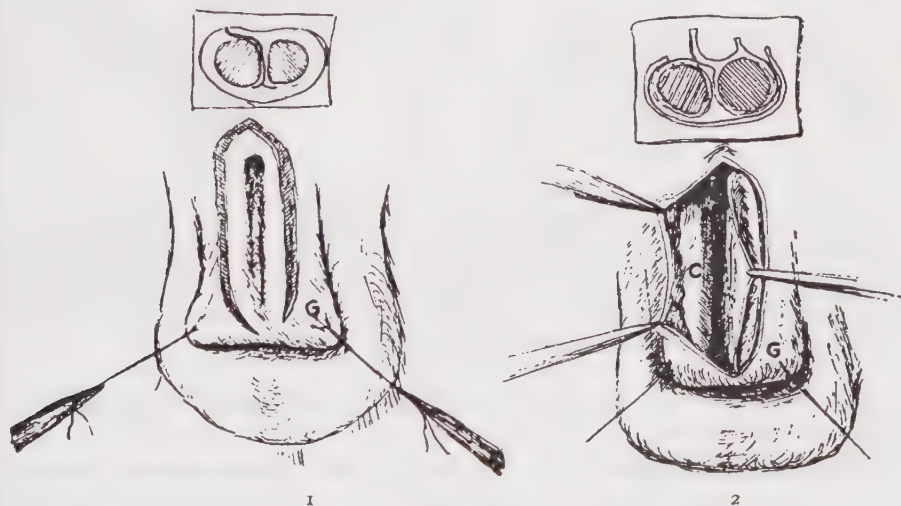


FIG. 276.—Operation for epispadias (Young).—I. The penis is held in position by two sutures placed in the glans (G). As indicated by the black line in the diagrammatic cross section, the incision on the left side goes only through the skin and down to the corpus while on the right the dissection is carried down between the corpora until the skin of the under surface of the penis is reached. 2. The separation of the corpora has been complete. The skin edge is being retracted to the right and the edge of the new urethra to the left exposing the right corpus (C) and exposing also the space between the corpora, the floor of which is formed by the inner surface of the skin of the under surface of the penis. The relations are clearly indicated in the cross section.

means of a pedunculated flap of skin from the pubis, with its epithelial surface next to the urethra (Fig. 274, 2) *A*. The raw surface may be covered with another flap *A'*, or the surfaces may be grafted with Jollier-Thiersch grafts.

The objection to this method of closure is the presence of hair, which always give trouble. This can be overcome by thorough depilation with radium or *x*-ray before the flap is used, or by the use of a flap, the under surface of which should be grafted successfully before

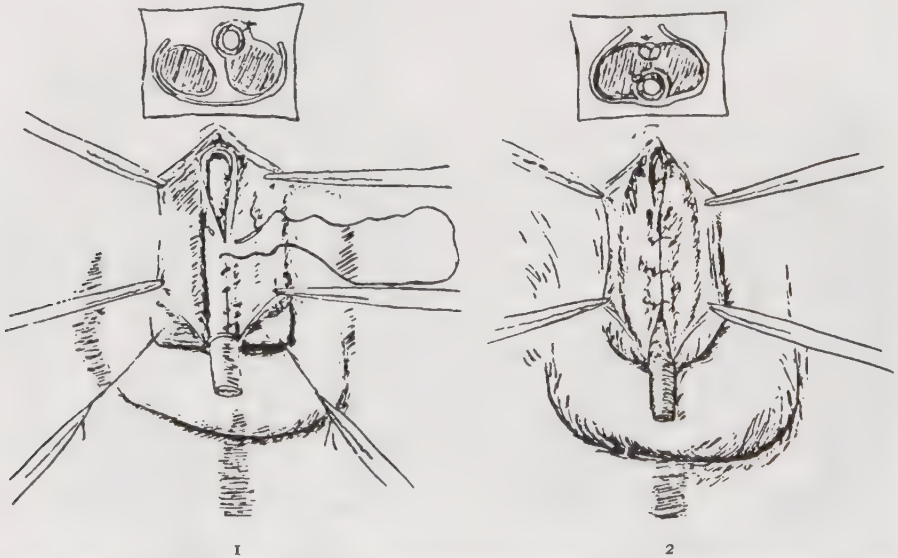


FIG. 277.—Young's operation for epispadias, *continued*.—1. The new urethra is being formed by a continuous suture, bringing the edges together over a catheter and converting the original groove into a tube. The attachment of the urethral tube to the left corpus may be distinctly seen both in surface view and cross section. 2. The right corpus has been rotated, carrying the urethra down to its new position below and between the corpora. The latter are sutured with interrupted sutures of chromic catgut. The unfinished suture line above permits a view of the underlying newly formed urethra.

being used to fill the defect. This method is much less satisfactory than the following:

Cantwell's Operation.—(1) A longitudinal incision is made on each side of the urethral groove along the line of the mucocutaneous junction from the symphysis to the extremity of the glans. The incisions are joined above the opening into the bladder and should be made down to the cavernous bodies without injuring them. The urethral gutter is then raised as a flap with its pedicle at the base of the penis, and is held aside.

(2) The corpora cavernosa are separated from each other by

sharp and blunt dissection, until the skin on the inner surface of the penis is reached. The urethral flap is laid in the gutter thus formed, and is held in position by one or two sutures through the skin. A glass rod, or rubber tube, is laid along the urethral flap, the edges are sutured over it to form a canal, and the rod is removed. Above the urethral canal, the corpora cavernosa are brought together and held

in position with sutures; the skin is then closed. The objection to this method is the possibility of slough of the urethral flap, due to poor blood supply (Fig. 275).

Young's Operation.—Hugh H. Young has recently published an operation which is an improvement on the Cantwell method, inasmuch as the blood supply of the urethral flap is assured. The plates describe the steps so well that detailed explanation is unnecessary (Figs. 276–278).

Successful results have been reported following Cantwell's, Young's, and other methods.

After becoming familiar with Cantwell's method some years ago, I had considered it the method of choice, but in future I shall adopt Young's method, as its advantage over the original Cantwell is obvious.

Epispadias in the Female.—This is a condition even more rare than epispadia in the male.

FIG. 278.—Young's operation for epispadias, *continued*.—The operation completed. The two outer edges of the original incision are easily brought together in the midline, making a penis and glans almost normal in appearance.

For epispadias in the female, Stiles and others, advise the transplantation of the ureters into the intestine as the only rational procedure. In other words they think that it should be treated by the methods already described in the chapter on Exstrophy of the Bladder.

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CHAPTER XIV

HYPOSPADIAS

Hypospadias is a congenital deficiency of the floor of the urethra

There are *three varieties*: (1) **Balanic, or Glandular**.—The urethral meatus is usually at the base of the glans. The meatus is small. The glans is broad, often grooved, and sometimes curved slightly downward. The frenum is absent; the prepuce is thickened and malformed.

(2) **Penile**.—The urethral opening may be at any place between the glans and the scrotum. The penis is often poorly developed, sharply curved downward and held in this position by a band of dense fibrous tissue. The scrotum is not cleft.

(3) **The Perineo-scrotal**.—The urethral opening may be at any point between the peno-scrotal junction and the perineum. The scrotum is cleft. The penis is poorly developed, curved downward and backward, and lies in the scrotal cleft. The testicles may or may not be fully developed and are often undescended.

Hypospadias is quite a common deformity. Gianturco has recently found it in 0.5 per cent of the men in the Italian army. Fortunately the majority of cases are of the glandular or penile types.

The indications for operation are inability to urinate normally and the impossibility of straight erection.

Quite frequently in the glandular form, and in those cases of the penile type in which the opening is fairly close to the gland, micturition and the procreative function are not materially interfered with. In these cases an operation is of doubtful utility, except for reducing the size of the prepuce, which is always redundant.

TIME OF OPERATION.—I seldom operate under six years of age and prefer to wait considerably longer. A number of my cases have been in adults and they do very well. In these older patients *post-operative erection* must be controlled by full doses of bromide by mouth or rectum, very light diet, and the ice-bags. Allowance for this erection should also be made in planning the flaps, and there should be no ten-

¹ My special interest in this malformation is due to the fact that a number of them have been referred to me through the courtesy of Dr. Hugh H. Young and Dr. J. T. Geraghty of the Brady Urological Institute of the Johns Hopkins Hospital.

on on the sutures. *The after care is all important.* Many operations which would otherwise be successful are spoiled by inefficient post-operative care.

TREATMENT

The success of every method for correcting these defects depends on the *thorough preliminary straightening of the penis*. This should be done before anything else is attempted. If the skin is tight, a transverse incision is made and the fibrous bands holding down the penis are divided or excised. These bands are composed of the poorly developed

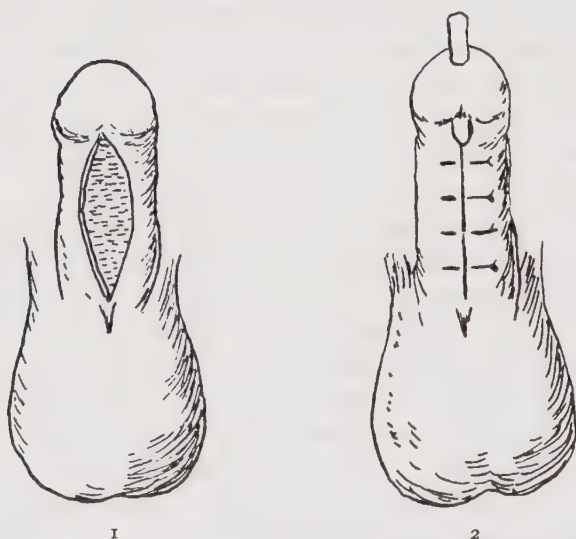


FIG. 279.—Operation for straightening the penis (*Duplay*).—1. The penis has been straightened after a transverse incision through the skin, and contracted fibrous bands. Note the longitudinal defect. 2. The transverse defect sutured longitudinally, with interrupted mattress sutures. The glandular portion of the urethra is shown completed.

corpus spongiosum, the thickened envelope of the penis and of the contracted septum between the corpora cavernosa. The skin defect is closed longitudinally or with a pedunculated flap, or is grafted (Figs. 279 and 28c).

In any operation in which the formation of the urethra, penile or urineal, is attempted, an external urethrotomy, or in selected cases suprapubic cystostomy should be done, and a permanent catheter inserted.

Of the numerous operative procedures advocated for the relief of hypospadias, I shall describe a few of the best. Every surgeon will have to adopt suitable modifications or combinations of the methods in order to fit the particular case.

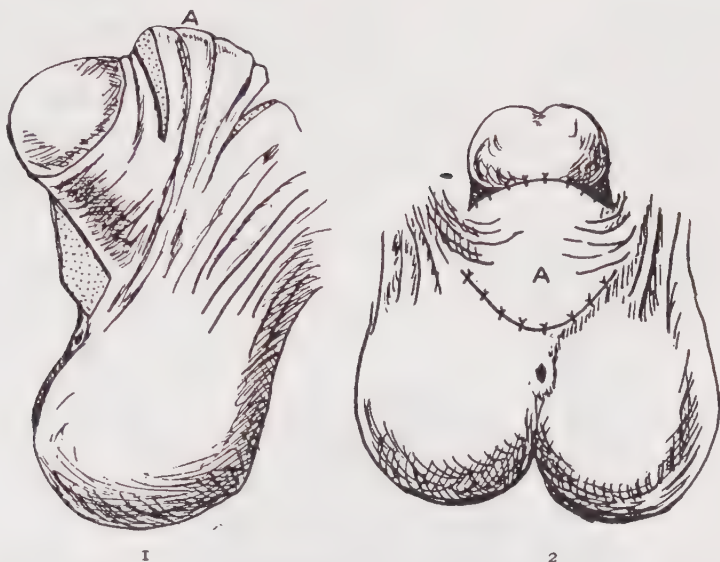


FIG. 280.—Operation for straightening the penis (*C. Beck*).—1. The dotted are on the under surface of the penis is the raw surface formed by straightening the penis after a transverse incision. The dotted areas on the dorsum of the penis indicate the incision made to form the flap from the prepuce. 2. The double pedicled flap of prepuce A is brought forward over the glans and is sutured into the defect on the anterior surface.

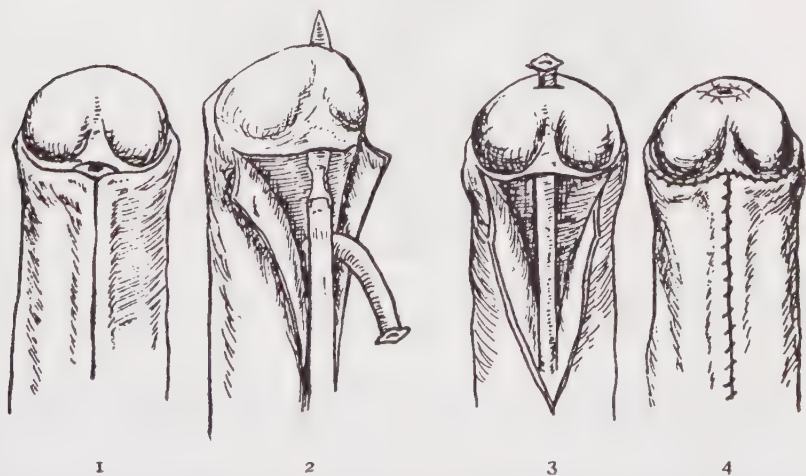


FIG. 281.—C. Beck's operation for a mild hypospadias (*White and Martin*).—1. The urethral opening at the base of the glans. The dark lines indicate the incisions. 2. The urethra separated. Note the cuff of skin left around its free end. 3 and 4. The urethra drawn through the slit in the glans and sutured. In these drawings the urethra is stripped so thoroughly that in actual practice it would probably slough.

Several methods of forming the urethra by means of free transplants have been introduced. N6ve-Josserand tunneled subcutaneously under the skin from just in front of the urethral opening to the end of the glans. Then after cutting an Ollicr-Thiersch graft he wrapped it around a glass rod with the raw side out and secured it at each end with a ligature. The rod with the graft around it was passed through the tunnel and after eight days the rod was removed. After this tube and the urethra were connected.

Segments of the saphenous vein were used in a similar manner by Stanton and others. A section of ureter from a fresh dead body was

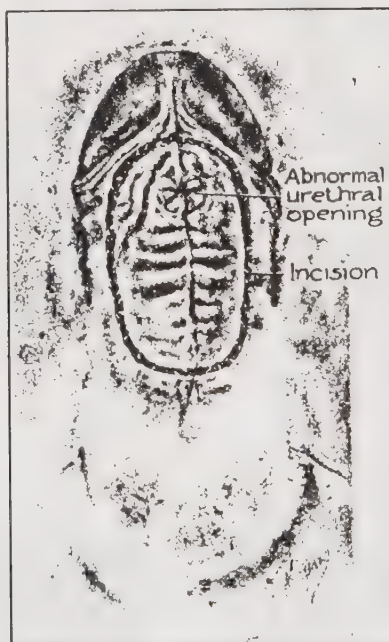


FIG. 282.—Operation for hypospadias (*Bevan*).—An oblong flap of skin is dissected off from around the abnormal opening, the portion of the flap toward the scrotum being larger than that toward the glans.

used by Schmieden; the appendix was used in a similar way by Streissler.

Cantas used a pedunculated flap of skin from the right thigh containing a section of a vein.

When the defect is to be repaired with a free transplant, a piece of tissue much longer than the defect must be used to allow for shrinkage.

These methods might be worth while in some cases, but for ultimate results they cannot be compared with the operations to be described below.

Operations for the Glandular and the Less Pronounced Penile Types. Beck's Operation.—Dissect out from its bed the distal end of the urethra with a cuff of skin, to enlarge it, and bring it forward through a tunnel made in the glans. (The urethra should not be stripped too thoroughly; otherwise its blood supply might be interfered with. Suture the borders of the cuff to the wound in the glans and close the skin over the urethra. Unless the urethra is long enough, erectility

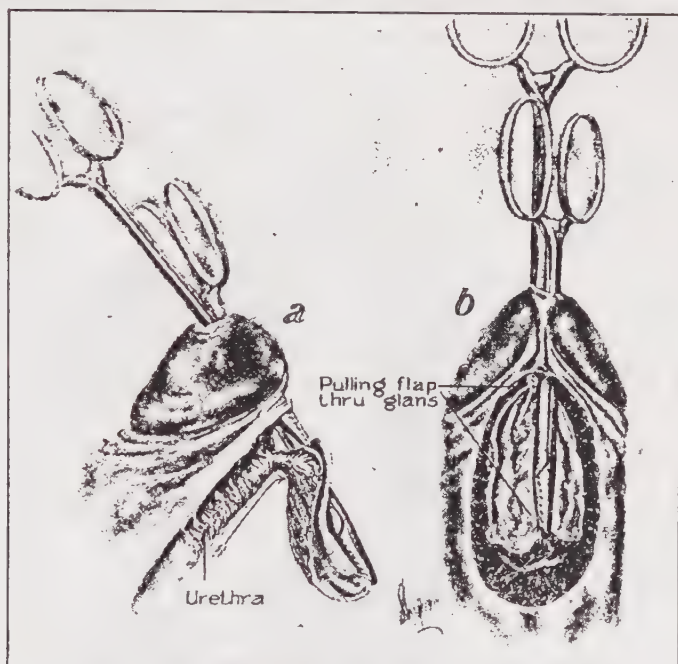


FIG. 283.—Operation for hypospadias, *continued* (Bevan).—A channel of considerable size has been made through the glans. Two mosquito clamps are passed through the opening and grasp the loosened flap at each extremity. The flap is then drawn through the channel.

will be checked. For this reason this operation is adapted only to very mild cases (Fig. 281).

Bevan's Operation.—Dissect up an oblong flap (the lower part being longer than the upper) from around the urethral opening. Make a free opening through the center of the glans so that the flap will not be constricted when it is brought through the opening. Pass the mosquito forceps through the opening in the glans and grasp the flap at its upper and lower extremities and gradually draw it up through the opening as shown in the diagram. Suture the edges of the flap to the margins of the wound in the glans and close the skin.

This seems a very rational procedure and Bevan says it can be used in cases where the opening is as far as 3.75 cm. ($1\frac{1}{2}$ inches) below the normal meatus. This operation prevents shortening of the urethra—the disadvantage of Beck's method—and also eliminates the possibility of a urethral slough (Figs. 282–285).

Operations for More Extensive Defects in the Penile Urethra.
Duplay's Operation.—The glandular urethra is formed in the same manner as already described in Thiersch's operation for epispadias. An incision is made on each side, about 1. cm. ($\frac{2}{5}$ inch) from the urethral

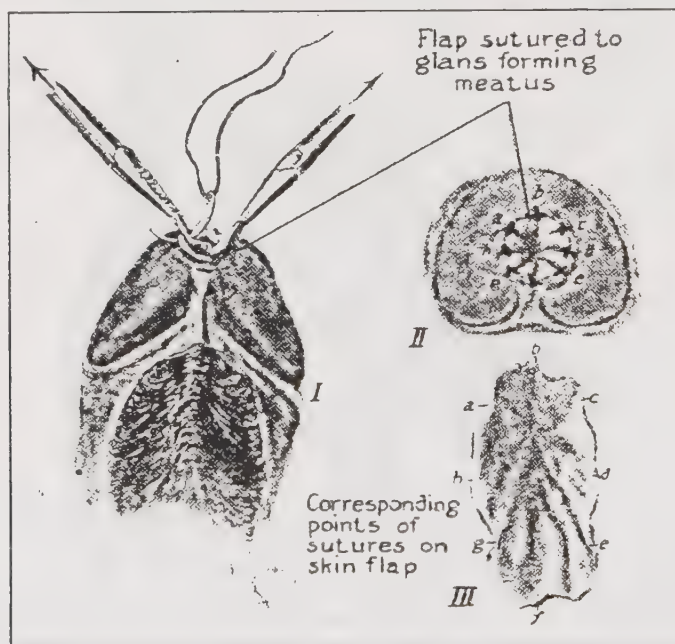


FIG. 284.—Operation for hypospadias continued (Bevan).—1. The sutures are being placed. 2. The edges of flap sutured to the margins of the channel in the glans. 3. The flap lettered to show the corresponding points of suture.

groove and extending from the glans to just beyond the urethral opening. At each end of these incisions a transverse cut is made beginning at the urethral groove and extending beyond the longitudinal incisions. (This incision can be lengthened subsequently if necessary.) By these incisions two flaps are outlined on each side of the urethral groove, one having its base at the urethral groove, while the other is in the skin of the body of the penis. These flaps are raised and those with their bases at the urethral groove are turned over a rod or rubber tube,

so that the skin surface is next to the rod. I prefer to make these edges meet and to suture them separately over the tube with fine catgut. In this way the urethra is completely lined with epithelium. The outside flaps are then brought in and closed with horsehair sutures. I have not found it necessary to use the lead plates advised by some authors for securing these sutures. After healing is complete and all induration has disappeared, the extremities of this newly formed urethra are joined above and below to the other channels (Fig. 286).

Bucknall's Operation. FIRST STAGE.—The penis is drawn up to the abdomen and the scrotum is drawn down between the thighs, so that



FIG. 285.—Operation for hypospadias. *continued* (Bevan).—The skin of the penis drawn in and sutured over the defect left by raising the flap.

the tissues are on a stretch in the midline. Then a longitudinal incision is made on each side of and 0.312 cm. ($\frac{1}{8}$ inch) from the midline extending from the glans to the abnormal urethral orifice. The incisions are now lengthened on each side of the scrotal raphe until the incisions below the urethral orifice on the scrotum are exactly the same length as those on the penis. This outlined area of skin 0.625 cm. ($\frac{1}{4}$ inch) wide (with the urethral orifice in the center) is allowed to remain undisturbed. From the extremities of the longitudinal incisions already made, ot

ncisions 0.625 cm. ($\frac{1}{4}$ inch) long are made at right angles, and the flaps thus marked out are raised on each side and rolled back. In this way are formed two long denuded strips 1.25 cm. ($\frac{1}{2}$ inch) wide on each side of the undisturbed skin in the midline. The flaps are held in the everted position and the penis is flexed down on the scrotum in the midline. Thus the median strip of skin and the raw surfaces will be brought into apposition. The strip of skin on the penis will form the roof and the scrotal strip the floor of the new urethra. The flaps formed on each

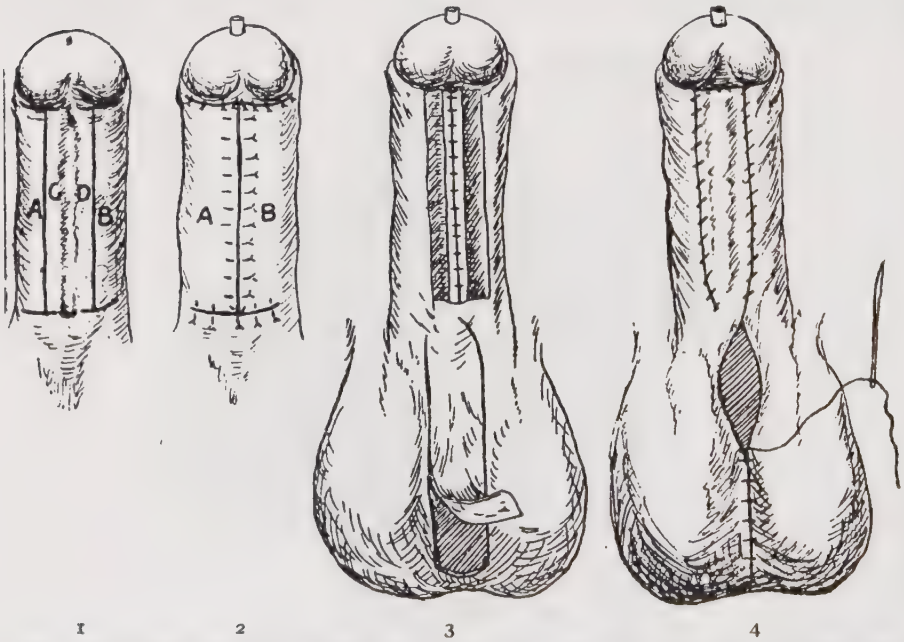


FIG. 286.—Methods of covering the penile urethra (formed by Duplay's method) with skin. (Modified after White and Martin).—1. Incisions for Duplay's operation. A and B lateral flaps. C and D central flaps. 2. Closure of the lateral flaps with on-end mattress sutures after the central flaps have been turned inward and the edges sutured. 3. The central flaps sutured. The lateral flaps being too short to close over the new urethra. A flap with its base above is outlined on the scrotum. 4. The scrotal flap is raised and sutured over the new urethra. The scrotal defect is shown partially closed.

side of the opposed penile and scrotal flaps are sutured as shown in the diagram, the stitches being about 0.625 cm. ($\frac{1}{4}$ inch) apart. All the sutures are placed before any are tied, small rubber tubes extending the length of the opposed flaps are inserted on both front and back, and the sutures are tied over them. Through the channel thus formed Bucknall then passes a small rubber catheter into the bladder through the newly formed urethra to drain off the urine. (It is better to do an external

urethrotomy and insert a permanent catheter.) The stitches are removed after fourteen days (Figs. 288 and 289).

SECOND STAGE.—Usually undertaken after three or four weeks, if conditions are favorable. The penis and newly formed urethra are dissected from the scrotum leaving lateral flaps of scrotal tissue on each side sufficiently long to cover the raw surface of the penis when the

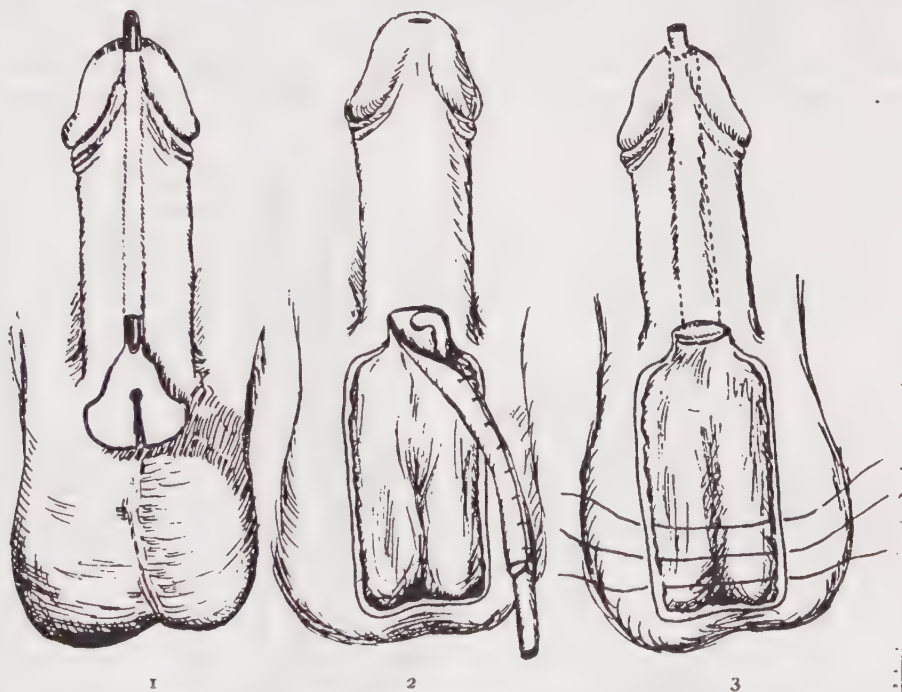


FIG. 287.—Operation for penile hypospadias (*Rochet*).—1. Through a short transverse incision, just above the abnormal urethral opening, a tunnel is burrowed beneath the skin and through the glans. 2. A pedunculated flap of sufficient length, with its base at the urethral opening, is raised from the midline of the scrotum, and is sutured, its surface inward around a rubber catheter, a portion of which is inserted in the urethra. 3. The catheter with the flap attached is then drawn through the tunnel previously made, and the end of the flap is sutured to the new meatus. The catheter may either be left 24 hours, to support the newly formed urethra, or may be removed at once. It is safer to drain the bladder through an external urethrotomy wound with a permanent catheter than to have the urine flow along the new channel, until healing is complete.

are brought together. The flaps and the scrotal defects are closed with sutures in the midline.

Bucknall reports good results in three cases. The disadvantages are that the method cannot be utilized if the scrotum is cleft; hair may develop on the skin from the scrotal raphé forming the floor of the new urethra.

Van Hook, and later C. H. Mayo, devised operations in which a tube, formed from a pedunculated flap obtained from the prepuce, was used to form the urethra.

Mayo's operation is performed as follows: "The prepuce is stretched for circumcision, and two incisions are made about 2.5 cm. (1 inch) apart extending from its border to its attachment at the penile cervix; the prepuce is unfolded, forming a loop of thin skin about 6.25 cm. (2½ inches) in length. Should this not be considered sufficient to reach from its attachment to the hypospadiac opening, the two incisions are extended back along the dorsum of the penis until sufficient tissue

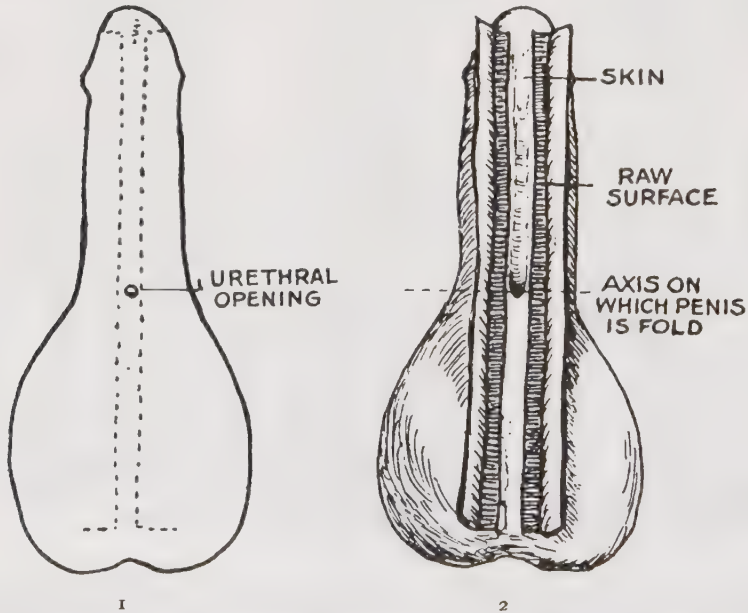


FIG. 288.—Operation for hypospadias (*Bucknall*).—1. The dotted lines indicate the incisions to form the flaps. 2. The flaps dissected up and reflected.

is obtained, where the two incisions are connected by a transverse one, and the flap of skin lifted but left attached to the cervix by the inner surface. Several sutures now close the lateral integument over the denuded area. The pedunculated flap of prepuce is constructed into a tube, with its skin or outer surface inside, by means of a number of catgut sutures. The penis is tunneled with a narrow bistoury or medium trocar and cannula, through the glans, above its groove, along the penis to a point beneath the hypospadiac opening, when it is made to merge at one side of, but close to, the urethra; the tube of prepuce is drawn through the tunnel and sutured where it enters the glans and also

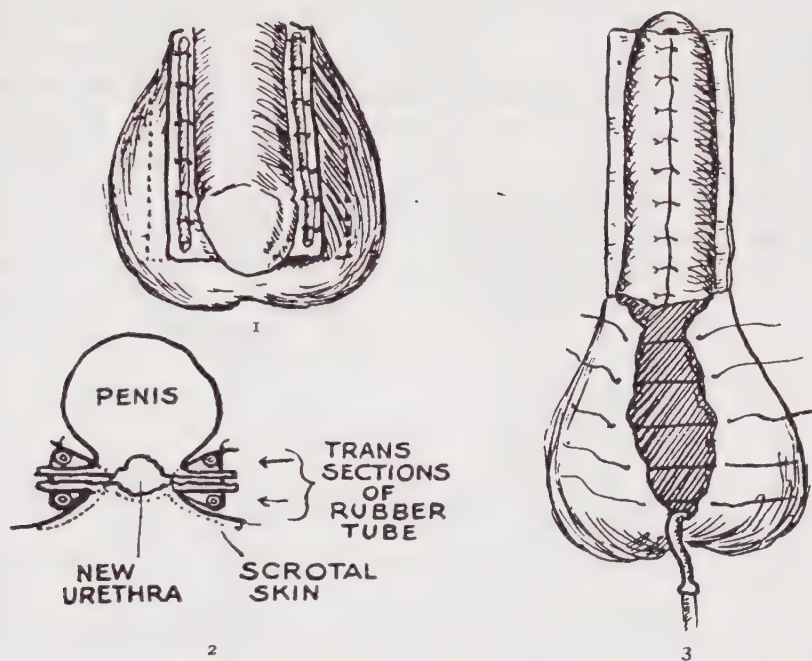


FIG. 289.—Bucknall's operation for hypospadias, *continued*.—1. Shows the penis fixed to the scrotum, and the flaps held together by sutures passed over rubber tubes. The dotted line indicates the scrotal flap to cover the under surface of the penis when it is dissected from the scrotum. 2. Scheme of holding flaps together by means of suturing over rubber tubes. 3. The penis is raised from the scrotum and the raw surface covered with skin flaps. The broad raw area on the scrotum is sutured.



FIG. 290.—Operation for hypospadias (C. H. Mayo).—A. 1. Scrotum. 2. Glans penis. 3. Raw surface after raising the skin for the new urethra. 4. Urethral opening. 5. Skin folded to form a tube. B. The pedunculated flap 5 folded in the form of a tube, passed through a perforation in the glans, and through a tunnel burrowed in the skin under the surface of the penis, and is brought out near the old urethra. Later the pedicle is cut and the ends of the tubes are joined.

where it emerges. At the end of ten days the pedicle of the flap is cut through close to the new meatus. The *second operation*, made at a later period, consists of a perineal opening into the urethra and insertion of a Jacobs' self-retaining female catheter; this is the least irritating form of catheter and can be left as long as needed, usually from five to eight days. An incision at the termination of the two urethras now admits of accurate coaptation by sutures, or the normal urethra may be mobilized (Beck's method) to a sufficient extent to admit of its insertion into the new urethra, where it is held by sutures and the external

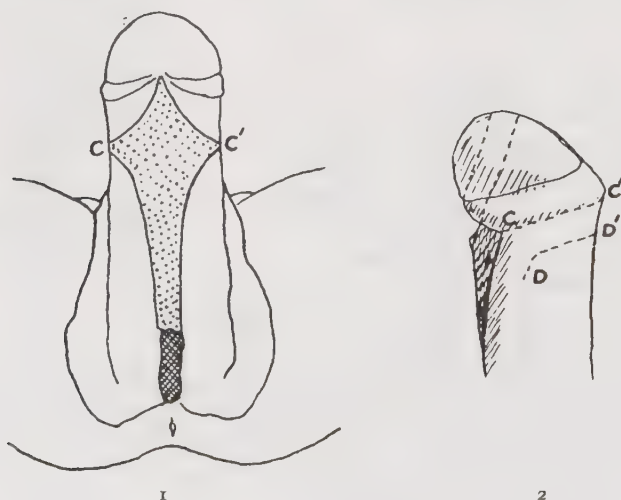


FIG. 291.—Operation for hypospadias (Russell, *Annals of Surgery*, Aug. 1907).—1. The penis is straightened by a transverse incision which divides the skin and all contracting bands. 2. The dotted lines through the glans indicate the channel made, which should be considerably wider than is shown. The dotted lines CC' and DD' indicate the outlines of the double pedicled collar flap of prepuce, with its pedicle between C and D on each side of the penis.

parts closed over this. Occasionally a little urine escapes into the urethra, and the entire canal is best drained by passing several strands of silkworm gut or horsehair through the urethra and out alongside the catheter in the perineal opening" (Fig. 290).

Russell's Operation. FIRST STAGE.—The skin binding down the penis is divided fairly near the glans by a transverse incision which may be lengthened as much as needed. Then the dense fibrous bands holding down the penis are either excised or divided until the penis is completely released. The result of this (when the penis is straightened) will be a long diamond-shaped skin defect. A channel should then be made through the glans as shown in the diagram and the surface of the glans

denuded for a short distance on each side of the incision. An incision curving slightly upward is made from one lateral angle of the defect on the penis to the other, across the dorsum cc' , 0.833 cm. ($\frac{1}{3}$ inch) below and parallel to this another incision dd' is made, beginning and ending about 0.833 cm. ($\frac{1}{3}$ inch) from the raw edge, and passing slightl

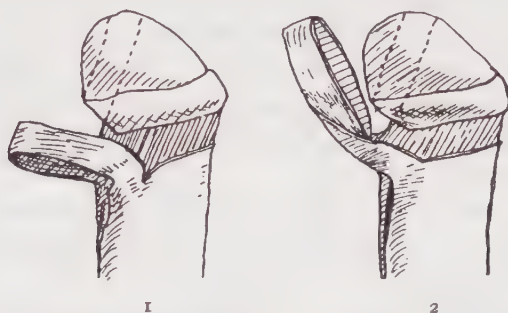


FIG. 292.—Russell's operation for hypospadias, *continued*.—1. The collar flap raised and drawn over the glans. 2. The flap is turned inside out so that skin is against skin.

downward at the extremities, thus giving a broad pedicle at each end of the flap. The flap is raised from its bed (care being taken not to encroach on the pedicles) until it can be passed over the end of the penis. The loop is turned inside out so that *skin is against skin* and drawn through the channel in the glans b and c . The loop is then divided

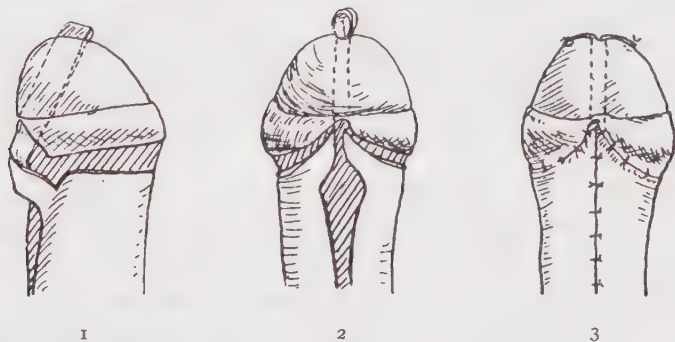


FIG. 293.—Russell's operation for hypospadias, *continued*.—1 and 2. The loop drawn through the channel in the glans. 3. The redundant portion of the loop is removed and the edges are sutured to the denuded portion of the glans on each side of the channel. All wounds are then closed.

the redundant portion is removed, and the edges are sutured with fine horsehair to the denuded surface of the glans on each side of the incision, thus preventing subsequent contracture of the meatus c . The wounds are then closed with horsehair. A self-retaining catheter is placed in the urethral opening to avoid soiling of the sutured line (Fig. 291-293).

SECOND STAGE.—This should not be done for some months. I have waited as long as a year. Preliminary to the formation of the rest of the urethra a small suprapubic opening should be made in the bladder and a permanent catheter sewed in. (When this method is used for a complete penile defect, an external urethrotomy is done.) In order to understand the minute details of the second stage of the operation I shall quote the author himself in part.

“Starting anteriorly, note in Fig. 294,1 the two folds of skin (AB, AC) that diverge from the opening of the glandular urethra to be lost in the body of the penis. These are guides for the direction of incisions for making the penile urethra.

Fig. 294,1 represents this region enlarged for clearness of demonstration. A is placed at the urethral orifice beneath the apex formed by the

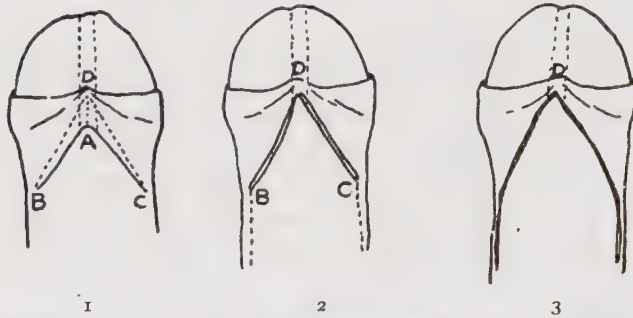


FIG. 294.—Russell's operation for hypospadias, *continued*.—1. The penile portion of the new urethra is at the point A. Slit the new urethra from A to D, and remove the tissue in the area DBAC. 2. Result of the excision. The dotted lines beginning at B and C indicate the upper part of the incisions for the formation of the penile urethra. 3. These incisions are continuous with the line BD and CB.

two folds of skin AB, AC. Make first the short incision AD which splits up the new urethra for about 0.312 cm. ($\frac{1}{8}$ inch). This will make the angular flaps DAB and DAC. Mentally complete the two triangles DAB and DAC by the dotted lines DB and DC.

With fine forceps and scissors remove each triangle cutting along the base lines DB and DC. Fig. 294,2 shows the result of the excision, and the cut edges of the two layers of skin of which the folds are composed; the inner layer is part of the preputial loop which has become the lining of the glandular urethra; the outer layer is continuous with the skin of the body of the penis.

Start the lateral incisions for the penile urethra from the points B and C respectively, and carry them down the penis as indicated by the dotted lines (Fig. 294,2). It is clear that the penile urethra will be con-

tinuous with the glandular portion (Fig. 294,3). We now turn to the perineum and draw apart the cleft scrotum and observe the two following landmarks, which are represented enlarged and very diagrammatically in Fig. 295,1.

(1) THE FINE RIDGE OR CREST (AA'), which separates the mucous membrane of the perineal urethra abruptly from the skin of the perineum. (Note that I wish AA' to indicate, not the short straight line at the anterior extremity of the urethra, but the long U-shaped AA' that passes backward round the urethral orifice, and forward again, as indicated by the little arrows in the diagram.)

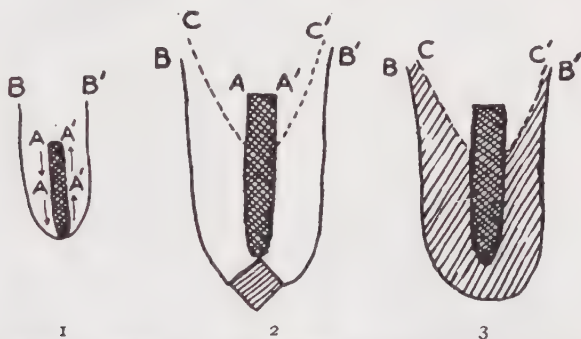


FIG. 295.—Russell's operation for hypospadias, *continued*.—1. The line AA' indicates the fine ridge which separates the mucous membrane of the perineal urethra from the skin of the scrotum. The surface line of the skin of the perineum BB' overlaps the urethral opening at its lowest point. 2. The overlapping portion is released by a short medial incision which exposes the lower portion of the perineal urethra and forms a small quadrilateral raw surface as is indicated by the shaded area. 3. The shaded area indicates the amount of skin excised around the perineal mucous membrane. Note that the skin adjacent to the upper fourth of the mucous membrane is not disturbed, as otherwise undue narrowing of the urethra would follow.

(2) THE SURFACE LINE OF THE SKIN OF THE PERINEUM (BB' Fig. 295,1, which overlaps AA' posteriorly more than is shown in the diagram. Between these two lines, AA' and BB', there is an area of skin, broad behind and gradually narrowing anteriorly, that is to be removed, leaving a raw surface. Proceed as follows: a short medial incision backward through the skin only, so as to completely expose to view the hinder part of the perineal urethra and the existing orifice. This incision will create the small quadrilateral raw surface shown in Fig. 295,2.

Separate accurately the perineal mucous membrane from the skin along the U-shaped line AA'. A good way to do this is to take firm scissors and clip away the thin crest that separates mucous membrane from skin along the line AA'. Note that this procedure must be carried

forward only so far as to the point where the dotted lines meet the perineal urethra (Fig. 295,2 CC'). At this point the mucous membrane must be left and the demarcation continued forward in the form of an incision along the dotted lines (CC'). This is to obviate undue narrowing of the urethra, with which we are threatened at this spot. The line of separation between urethra and other structures having been thus laid down, dissect away all the skin intervening between AA' and BB', as indicated by the shading in Fig. 295,3. This will leave a broad raw surface in the perineum, narrowing as it passes forward.

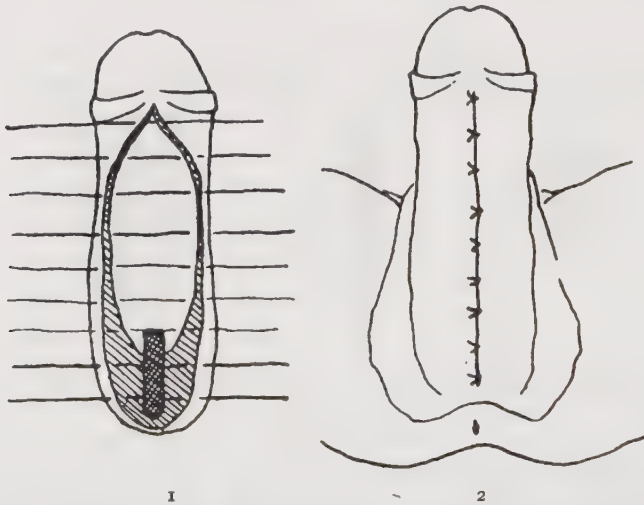


FIG. 296.—Russell's operation for hypospadias, *continued*.—1. The glandular urethra completed. The central flap of skin is separated: stitches are placed which will infold the central flaps to line the urethra, and cover it with skin. 2. The sutures tied and new urethra completed.

The operator must now strike a line for the lateral incisions that have been already made in the penile portion. In doing this, he for the first time seems, as it were, to leave the track and travel across country through, it may be, rather doubtful looking scrotal tissue. He must just plan his incisions so as to make the junction of the penile with the perineal urethra uniform in calibre with the rest. Although this has been the only point in the procedure at which I have experienced some feeling of uncertainty, healing has been quite satisfactory in this part in both my cases.

The entire length of the new urethra has now been marked out. The skin composing it is now to be carefully raised on either side, working toward the median line, sufficiently to permit it to fold easily over

to make the new urethra, without the least tension. All is now ready for the suturing.

Fig. 296.1. The new urethra and the skin of the penis are now brought together throughout by a series of sutures. Each suture includes four layers of skin, the needle passing in order through outer skin and urethral skin of one side, then through the urethral skin and outer skin of the other. I need not dwell on the necessity for extreme delicacy and accuracy in the performance of this final step of the opera



FIG. 297.—Perineal hypospadias. Patient 24 years old. No. 5559.—The urethral opening is about on the level with the cross mark. The testicles are apparently normal. The scrotum is bifid and the penis which is markedly curved forward, is considerably smaller than normal.

tion on the penile portion of the urethra, which is the only part of the operation in which the result is at all precarious. The perineal position, where the surface is broad, scarcely needs any suturing; the suture there will, of course, just miss the mucous membrane.

Fig. 296,2 shows the operation completed."

The objection to this operation is that hair will probably grow on the scrotal skin which is used to form the lower half of the urethra.

METHOD OF CHOICE

I prefer Russell's method of forming the glandular urethra, and have done a number of cases in this way without a single failure. It is somewhat difficult to understand the application of the flaps, but once understood, it is in my opinion the best method as yet devised.

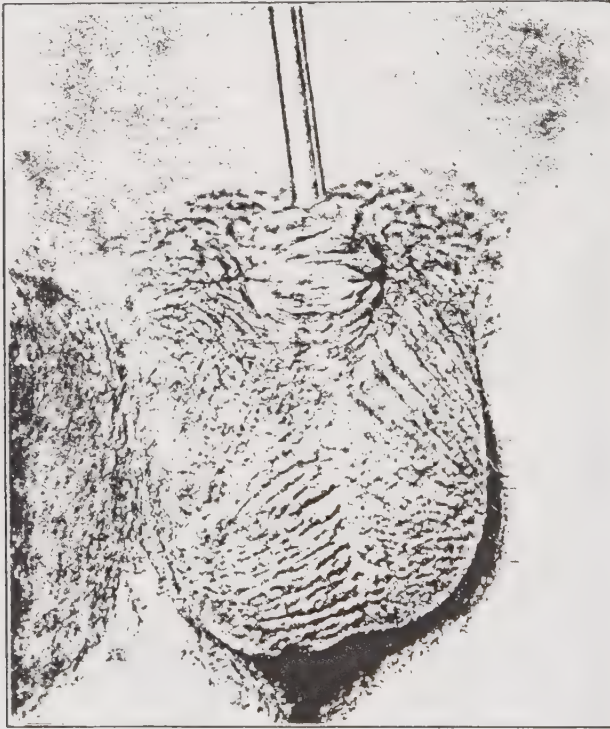


FIG. 298.—Perineal hypospadias, *continued*.—The result of several operations. The penis was straightened and the urethra in the glans was made by Russell's method. The penile and perineal urethra was formed by a modified Duplay operation, and then the newly formed sections of the urethra were joined. Several months were allowed to elapse between each operation. The photograph shows the operation completed, and with a No. 5 sound (French) passing through the newly formed urethra into the bladder.

The formation of the flaps in this way is very satisfactory, and can be used in the complete penile as readily as in the perineal type. I sometimes use the Duplay method for forming the penile urethra. No satisfactory way has been devised to avoid the use of scrotal skin in forming the perineal urethra below the penoscrotal junction, and as the growth of hair is the main objection to its use I would suggest that the hair follicles be destroyed with radium or x-rays (after carefully protecting the testicles) before the operation is done.

In suturing the flap which is to be the lining of the urethra, I prefer to close this with a separate line of sutures over a rubber tube, rather than to use the same sutures for both flaps. If possible the flaps should be arranged so that the suture lines will not be superimposed.

When closing the defect on the penis after construction of a new urethra, if lateral flaps cannot be utilized, I often employ pedunculated flaps from the scrotum.

For buried sutures very fine catgut is satisfactory. For the skin I prefer horsehair.



FIG. 299.—Hypospadias. Patient 7 years old.—1 and 2. The arrow indicates the position of the urethral opening. There is a groove in the glans. The penis is bent forward. The testicles are normal. Note the redundant prepuce. 3. The result of the formation of the urethra in the glans by Russell's method, and the upper portion of the glandular urethra by Duplay's method (the lower portion broke down). Note the probe passed through the urethra and the position of the penis, which was straightened. 4. Completion of the urethra. A flexible catheter has been passed through the urethra into the bladder. The outside surface of the lower portions of the urethra is made from a scrotal flap.

The tube over which the new urethra is formed should not be allowed to remain in place for longer than 24 hours. Most operators prefer to remove it immediately, but in some instances its retention for this period is distinctly advantageous.

Bladder irrigation with normal salt solution must be used every day when a permanent catheter is necessary. Urotropin by mouth is also useful to prevent bladder infection.

All operations for hypospadias, except in the mild cases, are done in stages. When the stitches tear out or infection occurs, the result may

not be completely successful the first time, and it may be necessary to perform quite a number of secondary operations to close those portions of the suture line which have not held. This repair should never be attempted until healing is complete, and all induration has disappeared.

Following any method of repair it is necessary gradually to dilate the newly formed urethra with sounds, until the urethra will take a No. 16 to 30 F. in an adult, and a No. 16 to 20 F. in a child.

The ultimate test of the success of an operation is the ability of the patient to urinate normally, and to have a straight erection.

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CHAPTER XV

ATRESIA OF THE VAGINA

We are interested here only in complete atresia of the vagina. The problem presented by cases in which the lower end of the outlet only is implicated are distinctly gynecological.

Our cases fall into *two groups*: (1) **Acquired atresia**, due to trauma, operation, infection, or severe cauterization. Since the uterus and appendages are usually present, the formation of a canal is almost always essential for the evacuation of the menstrual blood. (2) **Congenital atresia**, due to arrested development. In these cases the uterus and appendages are either missing, or are rudimentary in character. Both of these groups are rare, but in Marshall's experience the congenital type has occurred more frequently than the acquired.

It is very difficult in some instances to differentiate between a male pseudo-hermaphrodite with female development and a female with atresia. This point must be carefully taken into consideration before an operation for forming an artificial vagina is undertaken.

In instances in which there has been no collection of menstrual blood the defect may not be discovered until after marriage; in other cases the defect is discovered earlier, and the patients insist that something be done before marriage can be considered. In view of the fact that the birth canal will never be needed, we have to decide whether it is advisable in the particular case to make a vagina solely for the purpose of sexual intercourse.

In some cases after the defect is discovered the mental attitude of the patient is such that surgical intervention becomes inevitable. In others the formation of a vagina may be essential for a continuation of marital happiness.

The ethics in such cases have been the subject of a good deal of dispute. The operation should be undertaken only after mature consideration of all the various phases of each case.

There are two general methods of operative procedure which have given some measure of success. (1) **The formation of a vagina by the use of pedunculated skin flaps from the labia and skin of the thigh**. This procedure has been successfully carried out by Heppner, Roux,

icque, Vautrin, Ferguson, Beck, Graves, Juvara, and others. The method of Graves is probably the best of the skin flap operations, and the steps are well shown in the diagrams (Fig. 300).

Skin grafts have been used by Abbe, Forgues, Isaac, Tuffier, and others, and mucous membrane grafts (iso-vaginal mucosa) by Hirst, Küstner, and Mackenrodt, to line the cavity burrowed between the bladder and rectum. Flaps of peritoneum (Stökel) have been used,

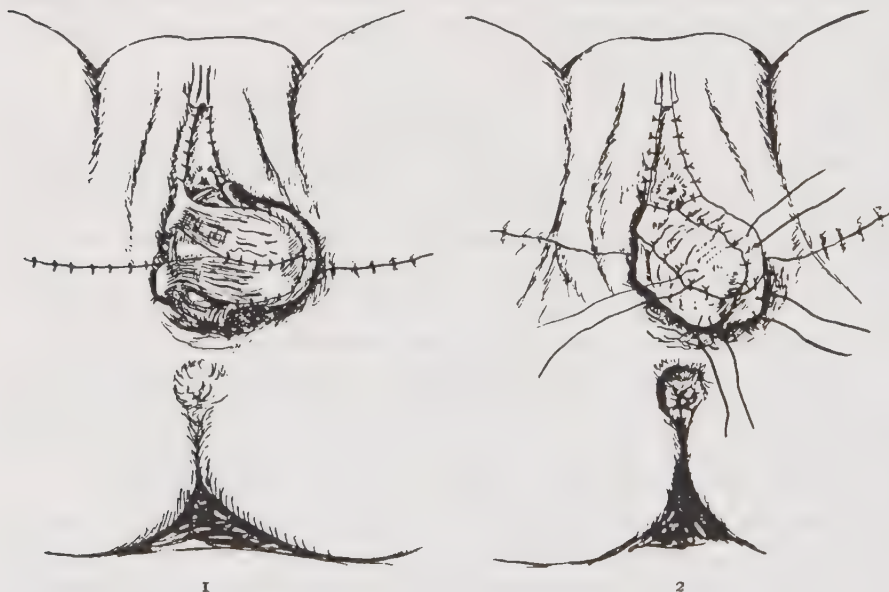


FIG. 300.—Operation for congenital absence of the vagina (Graves).—1. Through a transverse incision below the urethra a cavity of the desired size is burrowed between the bladder and rectum (care being taken not to enter the abdominal cavity.) This pocket is then lined by means of four pedunculated flaps. The labium minus on each side is dissected off from above downward in such a manner as to leave a pedicle sufficiently large to assure the circulation. The two surfaces are then split apart so that two paddle-shaped flaps are formed. A flap is raised from the inner side of each thigh with bases at the two lower corners of the artificial opening. All four flaps are sutured together over a glass form, skin side outward. Before the flaps are sewed together four catgut sutures with the ends 1 ft long should be placed in the vault of the artificial cavity. 2. When the suturing of the edges is nearly complete the glass form is taken out, and the long catgut sutures mentioned above are brought out through the skin pouch. The pouch is then inverted, the sutures are tied and the cavity is packed.

and also the lining of hernia sacs (Dreyfus). By none of these methods, however, has a really satisfactory vagina been obtained, on account of the tendency ever present to contraction, which in the majority of these cases cannot be overcome.

(2) **The Formation of a Vagina by Means of Intestinal Transplantation.**—Sneguireff, a Russian, first suggested the method and

transplanted the lower part of the rectum to form the vagina and the upper to form a sacral anus. He reported three cases up to 1904. In the same year, in this country, Baldwin suggested his method of transplanting a double loop of ileum, and since that time practically all of the successful work on these cases has been done by his method or some modification of it.

The sigmoid (Albrecht), and rectum (Schubert, Strassman, Aman and others), have been used. The use of the ileum—either double

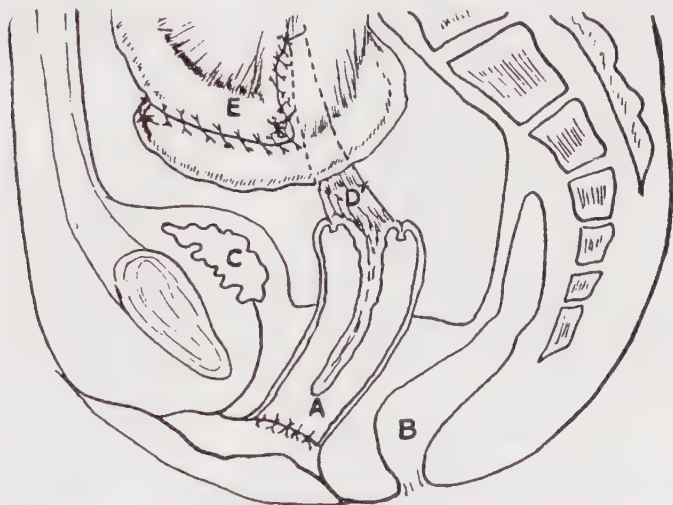


FIG. 301.—Baldwin's operation for the creation of a vagina (Quénu and Schwartz). The diagram shows the formation of a vagina by a double loop of ileum with its pedicle mesentery brought down and sutured to the skin margins of a channel burrowed between the rectum and bladder. The septum between the loops is divided subsequently. A. The double loop of bowel with its apex opened and sutured to the skin edges. B. Rectum. C. Bladder. D. Mesenteric pedicle. E. The ends of the ileum anastomosed laterally (Baldwin in his original operation used an end-to-end anastomosis with a Murphy button).

or single loops (Mori, Stewart, Wallace, Abbott, and others)—offer the most rational method, and quite a few good and lasting results have been reported.

Technic of Baldwin's Operation.—With the patient in the lithotomy position, through an incision between the labia, the bladder and rectum are carefully separated until the peritoneum is opened. (The vaginal canal should be made sufficiently large.) After the canal has been formed, the patient is put in the horizontal position, and the abdomen is opened by a low midline incision. The operator then selects a coil of ileum (quite close to the cecum), on account of its long mesentery, always making sure that the double loop will be long enough to reach the

vaginal outlet without tension. He isolates the coil with its mesentery attached and turns the ends in. He then makes an end-to-end or a lateral anastomosis to reestablish the continuity of the ileum (Baldwin uses a Murphy button for this anastomosis). The double loop of isolated bowel is drawn down into the opening between the bladder and rectum with a long pair of forceps passed up through this opening, until the apex of the loop is seen beyond the skin margin. The peritoneum is then closed around the mesentery and the abdomen is closed. The apex of the loop of the intestine is divided and the edges are sutured to the skin, just enough packing being placed in each loop to hold it in approximation with the surrounding walls. The

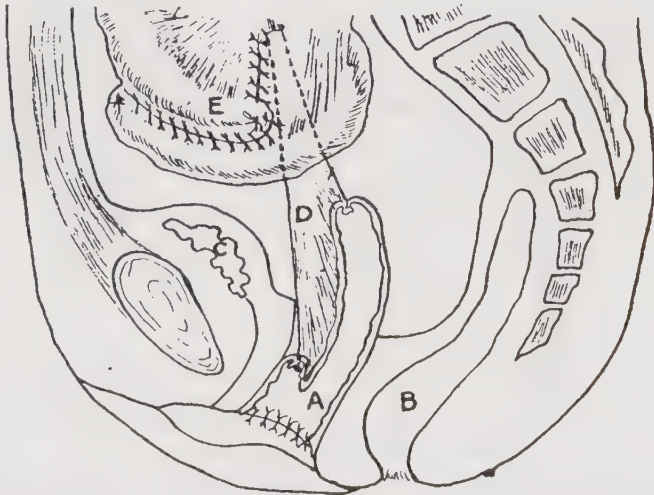


FIG. 302.—Operation of A. Schwartz for the creation of a vagina (*Quénu and Schwartz*).—The diagram shows the formation of a vagina by utilizing a loop of ileum. The operation differs from Baldwin's in that the upper loop is quite short. This gives the advantage of a large orifice without sacrificing so much bowel. A. New vagina. B. Rectum. C. Bladder. D. Mesenteric pedicle. E. Lateral anastomosis of ends of ileum.

packing should be removed from time to time, and the stitches after 14 days (Fig. 301).

In this way a double vagina is formed. The septum between the two canals can be divided after a few weeks, and healing will be prompt. The results reported by a number of operators are good. The vagina is large and shows no tendency to contract. If the uterus is in good condition the upper loop of bowel can be placed around the cervix so that the menstrual flow will not be impeded.

These operations are of considerable severity, and should never be undertaken until the dangers have been fully explained to the patient.

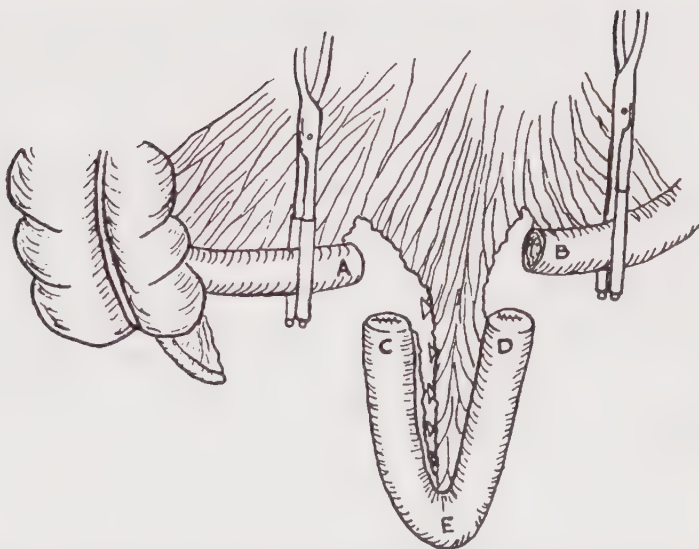


FIG. 303.—Operation for the creation of a vagina (F. T. Stewart; *Annals of Surgery*, Feb., 1913).—The segment of ileum CDE is isolated. The ends A and B are united by end-to-end anastomosis. The ends C and D are ligated and invaginated. The mesentery along the distal half C to E is drawn out between the bladder and rectum, the bowel at E attached to the vulval orifice, and the excess from C to E cut off.

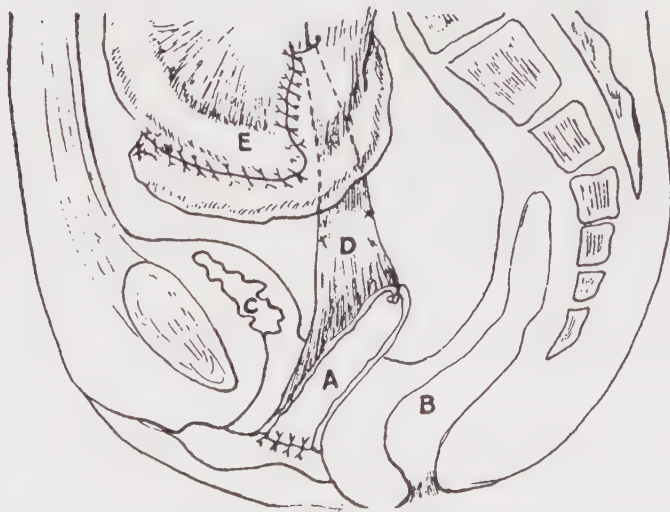


FIG. 304.—Mori's operation for the creation of a vagina (Quénu and Schwartz). Diagram showing formation of a vagina by a single loop of ileum. The open end of loop is sutured to the skin edges of the channel burrowed between the bladder and rectum. A. New vagina. B. Rectum. C. Bladder. D. Mesenteric pedicle. E. Lateral anastomosis of ileum.

Guggisberg reports a death following gangrene of a piece of bowel transplanted by Baldwin's method. This accident emphasizes the importance of preserving the blood supply of the loops of bowel until the new blood supply is assured.

The double loop has the following advantages: (a) it forms a much larger vagina; (b) it provides a better blood supply; (c) with it we avoid any subsequent dilatation so often necessary when the single loop is employed.

Marshall has collected a number of cases of pregnancy following the formation of a new vagina, mostly by plastic methods, but my understanding is that none of these were cases of *complete atresia*. In the great majority of cases the new vagina is constructed to prevent marital unhappiness or mental instability in the patient.

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CHAPTER XVI

PLASTIC SURGERY AS APPLIED TO THE VARIOUS REGIONS

GENERAL CONSIDERATIONS

In considering the operative treatment for the relief of deformities of the various regions of the body, I shall not attempt to describe the multitudinous operations which have been devised. My endeavor will be to consider only those whose principles are correct and which have been of use to me at one time or another. Many of the fundamental principles on which all well-planned plastic operations are based were described years ago and some of the original operations have yet to be improved upon. It is seldom that we have a case which is exactly the counterpart of the model on which the operative description is based, so that it is often impossible to make the incisions as described. When in doubt as to the best method for any particular case, my own procedure is to look over a number of operative suggestions and combine the points best suited to that particular case. Some of these operations are of considerable complexity, and an accurate description is most difficult. Nevertheless, with the aid of diagrammatic drawings the general methods of procedure may be understood and utilized.

The vast majority of plastic operations in civil practice have for their object the correction of old defects due to trauma, burns, or necessarily mutilating operations. A certain number of cases, such as defects left by the radical removal of carcinoma of the lip, should be repaired at once. In war surgery much can be accomplished by proper early care, but many of the final results shown in published articles could be greatly improved by subsequent plastic work.

The mental attitude of a certain group of patients who appeal to a plastic surgeon to correct very slight or imaginary deformities of the face must be given careful consideration. These patients are often suffering from melancholia with a suicidal tendency, and should be brought under the influence of a skilled psychiatrist. Operative treatment should be discouraged in this group, and avoided if in any way possible, because in the end, no matter how perfect it may be, the result is rarely satisfactory to such a patient.



FIG. 305.—Arteries of the skin of the head and neck (*Manchot*). *p.* Subcutaneous branches from the parotid. *sm.* Cutaneous branches of the submental artery. *cd.* Ascending cervicals from the occipital artery. *cs.* Cutaneous branches of the superficial cervical artery. *tc.* Cutaneous branches of the transversalis colli artery. *ts.* Cutaneous branches of the suprascapular artery. *ts'.* Subcutaneous supraclavicular artery. *ra.* Anterior and posterior branches of the supraclavicular artery. *raa.* Anterior auricular branches. *rap.* Posterior auricular artery.

SURGERY OF THE SCALP AND SKULL

SCALP

Plastic surgery of the scalp has to do with the repair of extensive defects due to operation, trauma, burns, disease, or infection.

The scalp extends from the superciliary ridges in front to the superior curved line of the occipital bone behind and, on the sides, to the temporal ridges. It consists of the skin and subcutaneous tissue, the occipito-frontalis muscle and its aponeurosis.

AVULSION OF THE SCALP¹

The most extensive lesions are those caused by avulsion of the scalp. In *complete scalping* the whole, or a portion of the scalp is entirely separated from the cranial vault and the adjacent skin. In the *incomplete variety* (which we shall not consider), the scalp is not entirely separated, but is left attached by a pedicle.

Etiology.—In the great majority of cases avulsion of the scalp is an industrial accident and the victims are females. The usual history is that the hair is caught on a rapidly revolving shaft and the force of the machine and speed of rotation is opposed by the weight of the body and the struggles of the victim.

The line of separation is, as a rule, at the junction of the scalp with the skin of the neck and face, or in other words where it is thinnest. The amount avulsed varies with the amount of hair caught and the duration and intensity of the force. Besson says that if the hair is caught at the back, the skin in front is torn first; if caught in front, the occipital region yields first; if caught on the top, the skin yields at the vertex and ears down to the ear on that side; when all the hair is caught at once the tearing begins at the eyebrows, following the line along the zygoma, around or through the ears, and finishes low on the neck (Figs. 306-309).

PAIN.—It is interesting that pain is rarely complained of at the time of the accident and fortunately in most cases there is little pain later, so that dressings are not especially trying.

HEMORRHAGE.—The bleeding may for a short time be very profuse and then cease; and a temporary anemia may result. In many cases

¹ For a full discussion of the subject of scalping, see J. S. Davis, Johns Hopkins Hospital Reports, vol. xvi. Since the publication of that paper a number of additional cases of scalping have appeared in the literature, but there has been no improvement in the method of treatment.

the shock is surprisingly slight, but occasionally there is complete collapse.

COMPLICATIONS may be divided into three groups: (1) Those which occur at the time of the accident, such as fractures, and other

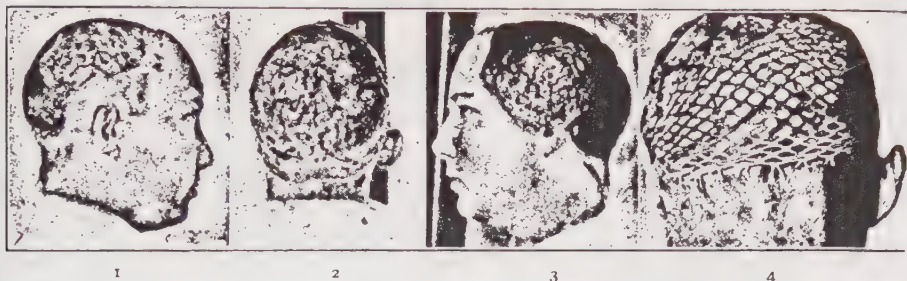


FIG. 306.—Complete scalping. Healing accomplished by the use of whole-thickness grafts.—1, 2 and 3. At the time of admission, twenty-two months after the accident (scalping, by hair being caught in rapidly revolving shaft), the granulations were exuberant and oedematous and could be moved from side to side. Photographs taken three weeks after admission. The granulations are clean and ready for grafting. The narrow zone of cicatrization seen on the edges shows the extent of healing during the twenty-two months which have elapsed since the accident, and indicates the slowness of unassisted healing in these cases. 4. The rubber impregnated mesh holding the whole-thickness grafts in position. By this means the grafts may be absolutely immobilized, which is a difficult matter in this situation. The button-holes in the graft can be seen.

injuries. These are quite unusual. (2) Those which occur during the progress of the treatment, erysipelas, abscess, necrosis of the bone etc. (3) Those which are due to cicatricial contracture. These con-

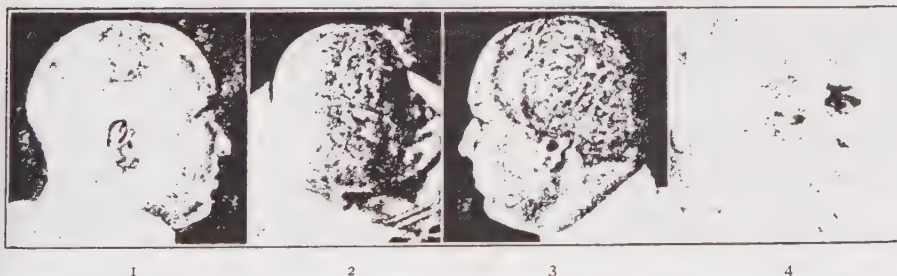


FIG. 307.—Complete scalping continued.—1, 2 and 3. Result of covering the denuded area shown in Fig. 306 with whole-thickness grafts. This gives a much more stable healing than when Ollier-Thiersch grafts are used in these cases. There is also less tendency to subsequent contracture. 4. The patient wearing a wig. Photograph taken one month after leaving the hospital. The ultimate result in this case has been satisfactory. The patient during the eleven years which have elapsed since grafting has been able to continue her occupation. There has been no contracture. Except for occasional superficial ulcerations between the grafts no complication has occurred during this period.

fractures cause hideous deformities, such as ectropion of the upper eyelids. Both lids are pulled upward and outward, and a Mongolian expression results. Occasionally an eye is lost from infection.

Treatment.—It is seldom that the plastic surgeon sees a case of calping immediately after the accident, it being usually referred to him after ordinary methods of treatment have failed. It might be said, however, that there is no authentic record of a case of complete calping in which the replaced scalp survived.



FIG. 308.—Complete scalping with spontaneous healing.—1 and 2. Condition five years after the accident. Multiple ulcers may be seen scattered over the thin scar. Note the superficial vessels in the scar. The eyelids are drawn upward and outward, giving a Mongolian expression. The lids could be closed only with an effort. The entire scar is tightly drawn over the underlying bone and the slightest injury causes an ulcer. 3. Two weeks after a relaxation incision was made across the forehead which was grafted with a single long Ollier-Thiersch graft. Note the relief of tension and the improved appearance of the ulcerated area, due to relaxation of the scar.

The problem is to combat infection, build up the condition of the patient, and to cover the area with skin. There has been a good deal of dispute as to the best time to graft, whether immediately after the accident, or after granulations have formed. My own preference is to



FIG. 309.—Complete scalping, *continued*. 1. Two weeks after making the relaxation incision and grafting. Note the ease with which the eyes are shut and the position of the lids. 2 and 3. Six months after grafting. Note the improved condition of the scar. The Mongolian appearance has disappeared and the closure of the lids is normal. There is still some sensation of tightness over the vertex. This will be relieved by properly placed relaxation incision with grafting.

wait until the defect is covered with granulations, inasmuch as the chance of success is greater on account of the improved blood supply and the patient is usually in better condition to stand operative procedures.

If immediate grafting is decided on, Ollier-Thiersch grafts are ordi-

narily used and are placed directly on the denuded area. Strips of the avulsed scalp (if not too much bruised) can be used, after proper cleansing, as whole-thickness grafts. If grafting is delayed, we endeavor to hasten the growth of granulation tissue over the surface of the defect.

If any portion of the skull is denuded of periosteum, this area should be kept moist with rubber protective until granulations form. The periosteum itself should not be allowed to dry out, as the bone beneath may become necrotic. If the bone dies the dead portion, if it does not exfoliate must be scaled off, or holes must be bored through it to the diploë with a fine drill, to allow granulations to form. The first record

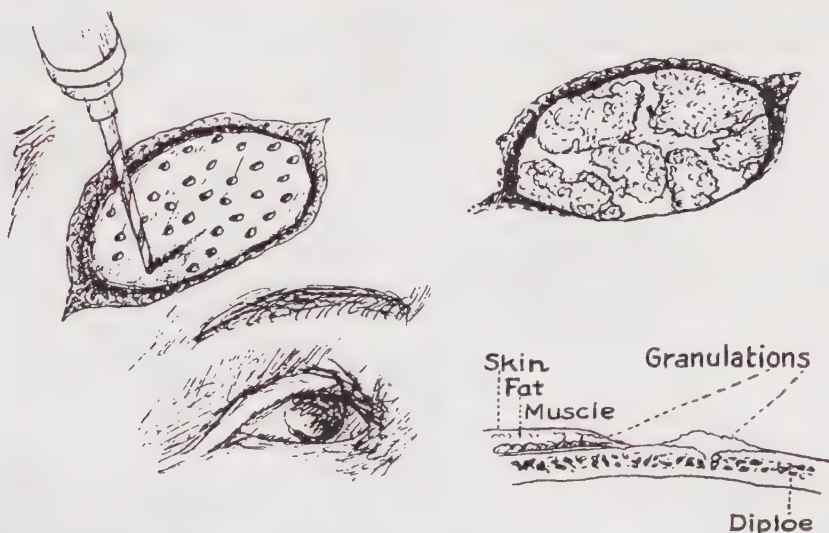


FIG. 310.—Operation for hastening the growth of granulations on denuded bone (Mayo). 1. Drilling through the bone of the skull to the diploë to allow the growth of granulation tissue. 2. Granulation tissue appearing through the perforations. Transverse section showing the granulations and the opening into the diploë.

of this procedure is that of Felix Robertson, who performed the operation in 1777 (Fig. 310).

If grafting is postponed until the granulations are formed, it may be either done partially or completely, depending on the size of the area and the amount of material available at one operation.

Ollier-Thiersch grafts are used by most operators. In some cases Reverdin grafts, or small deep grafts have been preferred. My preference is for whole-thickness grafts, as the healing in the end is much more stable than with the other types. The newly formed scalp is never as resistant as the original skin, and it is needless to say that there is never much hair on the healed surface, even when whole

hickness grafts have been used. Subsequently as a result of any slight injury small ulcers may occur over the surface, if grafted with Ollier-Thiersch grafts or Reverdin grafts, and between the whole-thickness grafts. These ulcers can be promptly healed with small deep grafts.

There is less danger of contracture after healing with whole-thickness grafts than with Ollier-Thiersch or Reverdin grafts. Occasionally a case of complete scalping will heal spontaneously after many months, but the result is generally bad, as subsequent ulceration and contracture always occur.

Sensation gradually returns from the periphery, both in the grafted areas and in those which heal spontaneously. A suitable wig should be worn after healing is complete and the appearance is surprisingly good.

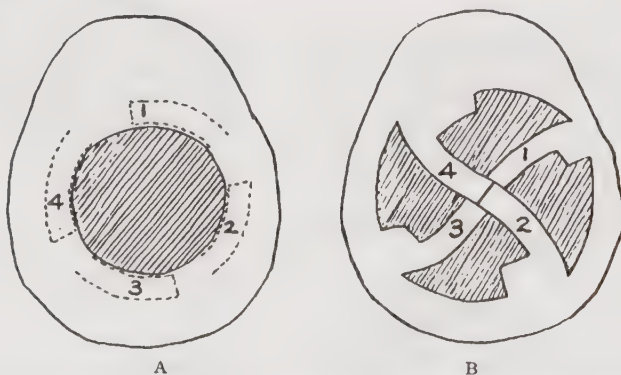


FIG. 311.—Operation for shifting in flaps for the repair of a scalp defect (*Tillmanns*). A. The shaded area represents the wound. The flaps 1, 2, 3, 4, are indicated by the dotted lines. B. The flaps shifted in and sutured to each other, dividing the wound into four smaller defects.

SMALLER DEFECTS may either be grafted or closed by a plastic operation such as the method of Tillmanns, who shifts in four pedunculated flaps of whole-thickness skin from the margins and sutures the ends together across the wound, dividing it into four smaller areas. The epithelium will then close over these areas much faster than over the single larger one. Or, if desirable, the smaller areas may be grafted (Fig. 311).

Ulcers.—We find at times chronic ulcers of the scalp of considerable size, due to tuberculosis, syphilis (broken down gummata), x-ray burns and carcinoma. The only method of treatment in these cases is complete excision, and then closure at the proper time by grafting or plastic operation. In a malignant growth the glands must also be excised.

Angiomata (arterial, venous, and cavernous) of the scalp are quite common, and may be excised or treated as in any other region.

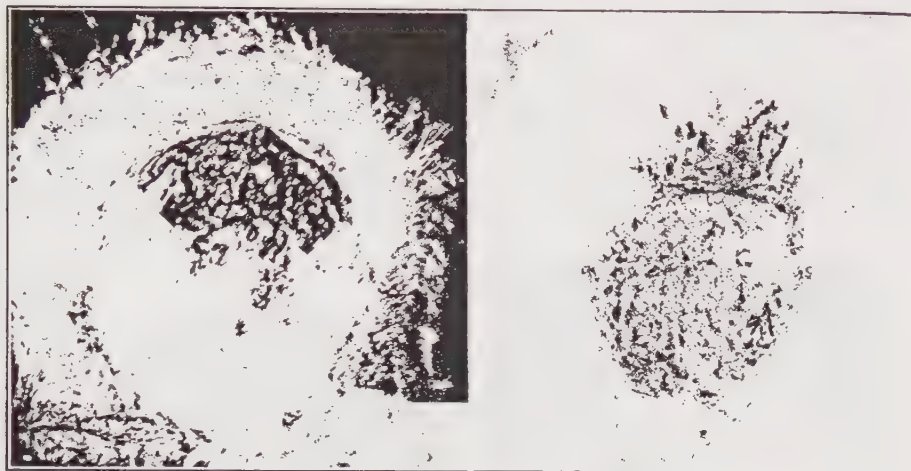


FIG. 312.—Ulcer of the scalp following the excision of an epithelioma with the cautery. 1. Before grafting. 2. After grafting with small deep grafts. This patient who was seven years old was grafted in the Out-patient department and only returned to the hospital for dressings. No recurrence has followed.



FIG. 313.—Rodent ulcer, in front of the ear. Duration several years.—1. The ulcer had been treated with X-ray and radium and is complicated by a burn. The anterior portion of the helix and front of the ear is involved as well as the skin. 2. The ulcer was excised and the ear shortened after the excision of the diseased tissue. In order to avoid a bald patch in this area a pedunculated flap of scalp was turned down and sutured into the defect, and the rest of the area was grafted. 3. The result of the operation. Note growth of hair on the flap. The hair has been brushed back to show the grafted area above. 4. The hair brushed down to cover the bald spot. This is a useful method: flaps of hair-bearing skin may be shifted in to fill areas which would be conspicuous without hair.

Fibrous Growths.—True fibromata on the scalp are rare. Occasionally, however, they grow to a large size, and are referred to the plas-

surgeon. The only satisfactory method of treatment is by partial gradual excision, or complete excision at one time, the defect being closed by grafting, or, if not too large, by plastic operation.

Keloids are found quite frequently on the scalp, especially in the negro race. They occur in old scars due to operation, or to local infection (furunculosis). The treatment has already been considered in the chapter on keloid.

In scalp defects, especially of the forehead, I have found it useful at times to employ pedunculated flaps from distant parts.

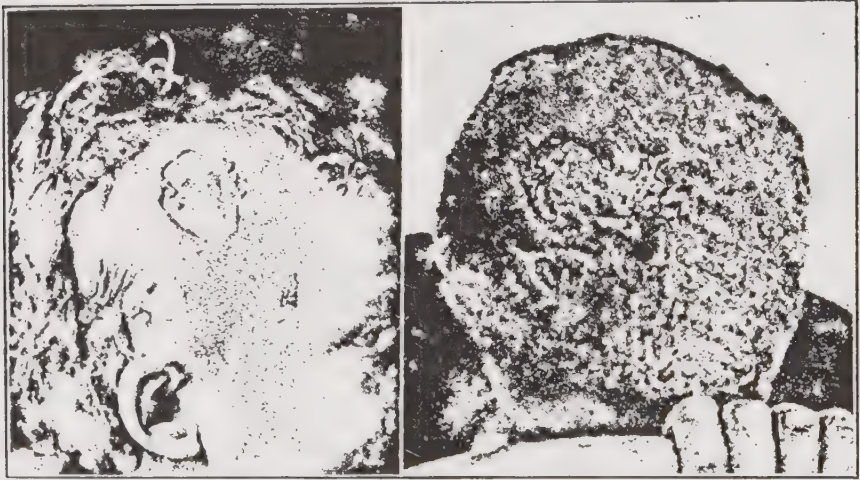


FIG. 314.—Necrosis of the skull following infection. 1. Exposure and necrosis of the parietal bone following acute streptococcus infection. Note the few granulations springing up. Boring holes down to the diploë is the method of choice in treating a case of this kind. 2. Necrosis of the parietal bone (Luetic). Note the multiple openings through the scalp, and the black necrosed bone. Removal or sloughing of the entire necrosed area is necessary before healing can take place.

SCALP DEFECTS ASSOCIATED WITH BONE NECROSIS

The plastic surgeon sees a number of cases in which the unprotected bone is necrosed. This condition may result from trauma, burns (thermal, electric, or x-ray), from syphilis, tuberculosis, or malignant disease. Extensive areas of bone may be lost in this way. In those instances in which only the outer table is involved, the area may be covered with adjacent skin by plastic closure; a pedunculated flap from a distant part may be used, or skin grafting may be employed. In those cases in which it is necessary to remove both tables of bone (for malignant disease, or where necrosis has already occurred), some

method of filling the bone defect must be considered in addition to the closure of the skin. The best procedure for this will be considered below

SKULL

The plastic surgeon is often consulted as to the best method of closing a skull defect and correcting the deformity. A wonderful opportunity has been presented in the war wounds of the skull to determine the most rational and safest methods.

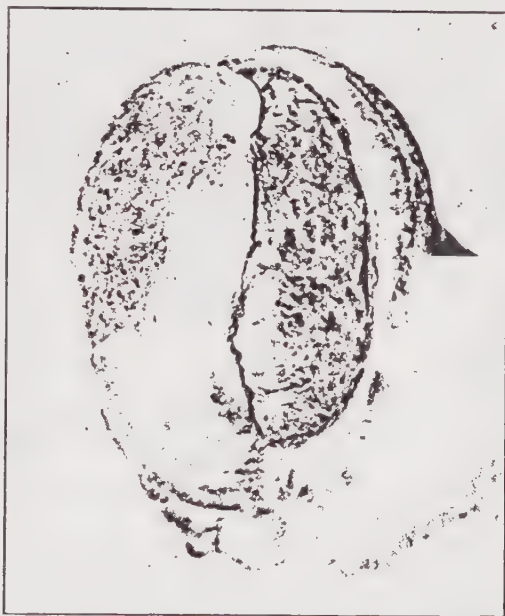


FIG. 315.—Sequestrum of the outer table of the skull, following a burn. (Surg. 30989).—The burn occurred eleven months before admission. The sequestrum was moved in one piece and the defect was grafted with small deep grafts. (This case was under my personal care.)

In cases of cranial defect no reparative operation should be undertaken until the healing of the original wound is complete, and the chance of infection (which may be started by cutting through a recently healed scar) can be eliminated.

Asepsis should be maintained most rigorously, as post-operative infection is disastrous.

Several methods of closing skull defects may be mentioned.

(1) **With Periosteal, Osteo-periosteal, or Cutaneous-osteoperiosteal Flaps.**—Many ingenious operations have been devised for closing

defects by the use of pedunculated flaps (simple or compound) from adjacent tissue, but I shall not consider them at this time, inasmuch as war experience has demonstrated the success to be obtained from the less complicated methods of direct transplantation.

(2) **Decalcified bone; isocranial bone; the bones of animals, and even cowhorn** have been used with more or less success.

(3) **Prosthetic Method.**—Very thin plates of gold, silver, aluminium, platinum, celluloid and ivory have been used, and the simplicity of the measure makes it attractive. Nevertheless the same objection exists here as elsewhere to burying non-absorbable inorganic substances, because if any infection should occur, the plate must be removed.

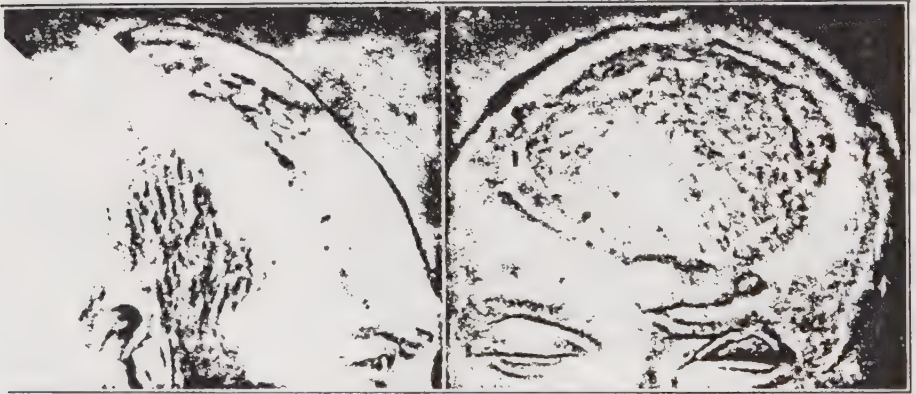


FIG. 316.—Luetic osteomyelitis of the skull. (Surg. No. 37639). A. The outer table of bone has been removed over the area between the brows and the vertex of the skull. The defect has been grafted. Note the peculiar slope of the forehead. B. Front view with eyes closed. Note the ectropion of the upper lid following scar contracture. (This case was not under my personal care.)

Good results have been reported by the use of this method, but I prefer the bone or cartilage transplants.

When plates of any sort are used it is best to perforate them with a number of small holes. In this way they are made lighter, the blood or serum can escape through the holes, and subsequently little plugs of tissue grow into them. The method of preparation before inserting the plate is much the same as will be described for bone or cartilage grafts. Most authors agree that the plate should be made to fit the defect exactly, and be held in position by several arms which rest on the surrounding skull. These arms should not be placed on a cranial suture. When celluloid or ivory is used, it must rest on the bone surrounding the defect or on a ledge cut to receive it.

(4) **Fascia and Skin.**—Free *fascia lata* transplants have been used with success for closing skull defects (as well as for dural defects) and good results are reported. It may be sutured to the pericranium, or the edges of the flap may be tucked between the dura and the bone. The result is a strong, resistant membrane.

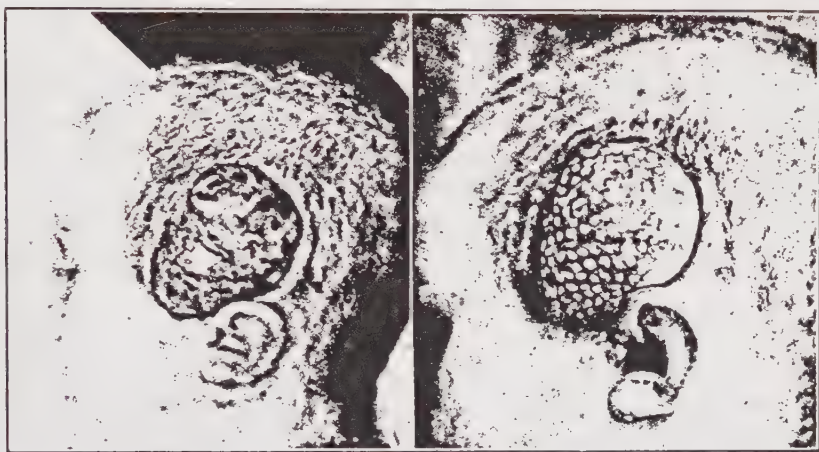


FIG. 317.—Hernia of the brain following a decompression for the relief of an abscess of the temporal lobe. (Surg. No. 28923).—1. Before grafting with small deep grafts. One week after grafting. The skin rapidly covered the tumor and simplified the care of this patient.

Experimentally I have found that the fascia when applied in either of the ways described above, eventually blends with the surrounding tissues, and forms a taut, non-stretching membrane.

Skin.—Begouin has described an ingenious method of utilizing pedunculated flaps of the scalp for closing a cranial defect, which



FIG. 318.—Cranioplasty for a small defect by the use of scalp flaps (Begouin).—The arrows show the flaps of scalp split off on the under surface and turned into the defect.

appropriate for small defects when cartilage cannot be utilized. The method is well shown in the diagram and will require no further explanation. It is important after closure by this method to exert even pressure to obliterate dead spaces (Fig. 318).

(5) **Cartilaginous Grafts.**—Autografts from the costal cartilages are preferable, but good results have been reported from the use of isografts.

The technic in brief is as follows: The incision best suited to the case is made down to the subaponeurotic layer and the defect is exposed. The island of scar is excised, but care should be taken during the dissection not to perforate or disturb the thin fibrous tissue plug which fills the dura defect. Cut through the pericranium around the edge of the bone defect and clear the edges of all spicules of bone, so that an instrument can be passed between the dura and bone. Then remove the grafts from the costal cartilage as previously described.

In order to hold the grafts in place a network of fine catgut is made (in both directions if necessary), passing through the pericranium on

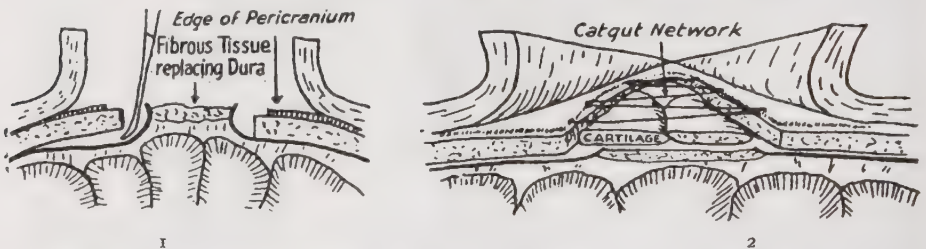


FIG. 319.—Method of repairing cranial defects with cartilage grafts (Woodroffe).—1. Diagrammatic drawing showing the clearing of the margin of the defect, including the preparation of the dura on the deep surface. 2. The cartilaginous grafts are inserted between the dura and the catgut network.

both sides, after Villandre's method; under this the grafts are slipped. The perichondrial side should be next to the dura; the grafts should overlap and may even be placed in a double layer. The cartilage may also be placed across the defect and rest on a ledge of bone, as described in the next section (bone grafts). It may be secured with catgut, or a very close fit may be made. In the frontal and temporal regions care should be taken to match the contour of the normal side as closely as possible (Fig. 319).

Hemostasis is essential. The healing should be as perfect as possible, and every care should be taken in suturing the flap. A twisted silkworm gut, or horsehair drain is desirable for 48 hours.

Many good results have been reported following the use of cartilage grafts by Morestin, who first introduced the method, by Gosset, Villandre, Woodroffe, and others.

(6) **Bone Grafts.**—The defect is exposed by any incision desired, which should extend through the scalp only. The opening is prepared

in a manner similar to that already described under cartilage grafts. The pericranium is raised for about 2.5 cm. (1 inch) around the opening and a strip of the outer table of bone about 1.25 cm. ($\frac{1}{2}$ inch) wide is removed all around the defect, the object being to make a ledge on which the bone graft is to rest.

The bone may be obtained from the outer table of the skull adjacent to the defect, from the scapula, the great trochanter, or most commonly from the tibia or ribs. My preference is for the ribs. Autografts are preferable, although isografts may be used. The bone (with its periosteum, if possible), after being shaped to fit snugly, is placed on the ledge previously prepared. The periosteum, if present, is sutured to the pericranium, or a catgut network may be used. The defect should be covered completely. A single graft is preferable, but multiple grafts are very satisfactory, and many good results have been reported. The skin is carefully closed with horsehair. A silkworm gut or twisted horsehair drain may be desirable.

Experimentally I have found that bone will soon fill the space between, if the strips of rib not touching each other, are laid across an opening in the skull. Moreover, if bits of bone are scattered on the soft parts in the defect, a solid closure will result, the under surface of which is smooth.

Cartilage or bone transplants are unquestionably best for filling cranial defects; some operators prefer the former, some the latter. My own preference is for cartilage; it is easy to obtain and is much more plastic.

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CHAPTER XVII

SURGERY OF THE EYELIDS (BLEPHAROPLASTY)

Quite a number of patients needing surgical care of the eyelids have been referred to me by ophthalmic surgeons; others have come under my care in connection with the correction of more extensive deformities of the face.

Before attempting this work one should become familiar with the principles involved and with the methods of procedure. Unfortunately even with proper treatment, the results may be unsatisfactory.



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FIG. 320.—Pigmented mole of the eyelid.—1. Note the size and shape of the mulberry like mole on the lower lid. The problem was to remove the mole with a sufficient margin and at the same time to close the defect without distortion of the eyelid. 2. Note the scar left six months after excision. The defect after excision was rectangular in shape. Incisions were then made from the upper and lower extremities of the defect outward and inward, parallel to the natural folds of the skin, and the flaps thus formed were shifted in and sutured in the midline. The shape of the sutured area being that of an H on its side. There is no constriction of the lower lid, and the scar can scarcely be noticed.

The object of the operator is to replace the destroyed tissues with normal skin in the way best suited to the individual case. It is always desirable to overcorrect in all operations on the lids, because we have to allow for subsequent shrinkage.

The type of operative procedure depends on the depth of destruction. For instance, if the tarsus and conjunctiva have been destroyed in addition to the skin, in order to reconstruct an eyelid some form of epithelium-lined flap must be provided.

If the skin surrounding these deformities were always normal, the operations shown in the diagrams would be comparatively easy. As a matter of fact, in the great majority of the cases which have come under my care, either the tissue surrounding the defect consisted of scar

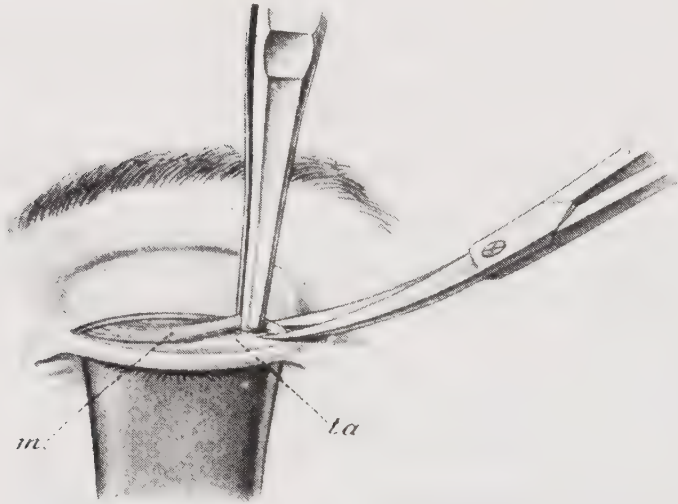


FIG. 321.—Hotz-Anagnostakis operation for entropion.—Excision of the fibers of the orbicularis muscle (*m.*) covering the tarsus (*ta.*). With forceps the fibers are grasped at the left angle of the incision; a small pair of curved scissors is applied close to the tarsus, and with short cuts the muscle is separated along the entire length of the lid (*Meller*).

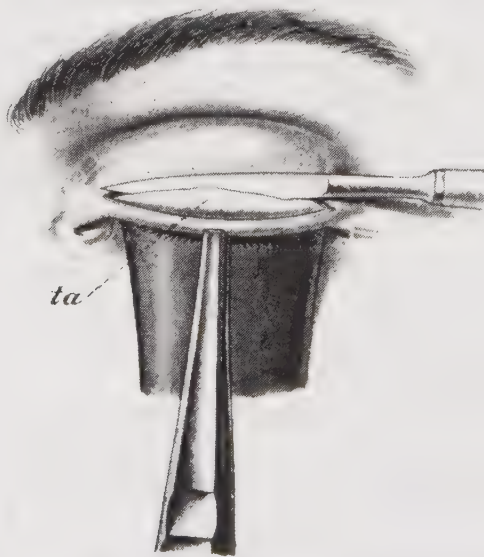


FIG. 322.—Hotz-Anagnostakis operation, *continued*.—With the knife applied flat against the convex anterior surface of the thickened tarsus (*ta.*), thin slices are cut. The upper border of the tarsus and the margin of the lid are not disturbed (*Meller*).

or the skin of the entire face was infiltrated with scar tissue. In such cases it becomes necessary to utilize the scar tissue wherever possible,

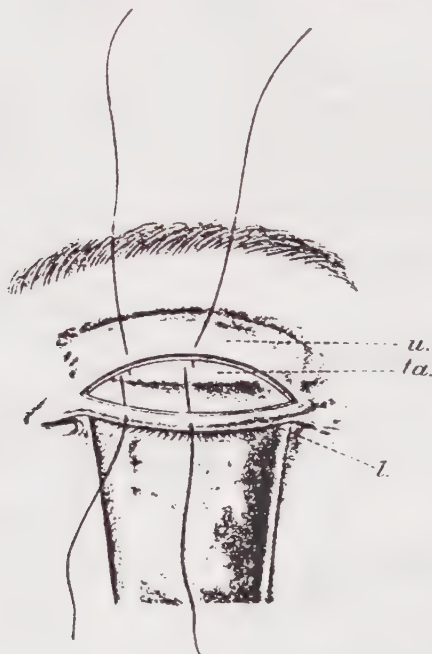


FIG. 323.—Hotz-Anagnostakis operation. *continued*.—Two of the sutures are applied. They pass from above through the skin (*u.*); then through the upper border of the tarsus (*ta.*), in which they are firmly fastened; and lastly through the lower margin of the skin (*l.*) above the cilia. Corresponding to the convex form of the upper tarsal border, the tarsal point of insertion of the outer and inner suture is nearer the lower margin of the wound than that of the middle suture (*Meller*).

and much can be accomplished if the scar is movable and can be shifted. However, normal tissue should be used if the defect is to be permanently corrected.



FIG. 324.—The tarsus has been bent forward during the closing of the skin-wound. The eyelashes are directed forward and slightly upward (*Meller*).

RECENT WOUNDS

If by chance a recent wound of the eyelids should be referred to the plastic surgeon, the parts should be properly cleansed and then brought together, care being taken that the conjunctiva is sutured to conjunctiva, skin to skin, etc. Much can be accomplished, even when the tissues are badly lacerated, by a few sutures judiciously placed.

Preliminary Preparation.—The eye should be irrigated every three hours with warm salt solution on the day before operation, in the interval

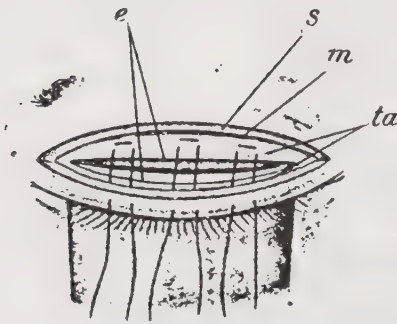


FIG. 325.

FIG. 325.—Snellen operation, for entropion (*Meller*).—A wedge-shaped piece^a (*e.*) of the tarsus is excised. Sutures in place. *s.*, skin; *m.*, muscle; *ta.*, tarsus.

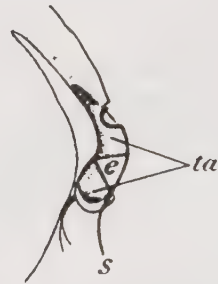
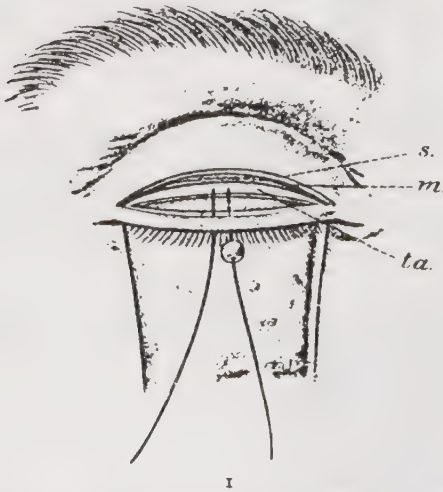
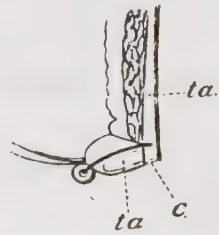


FIG. 326.

FIG. 326.—Snellen operation, *continued*.—Vertical section through the upper lid, showing the cuneus-shaped excision (*e.*) of the tarsus (*ta.*), with the suture (*s.*) (*Meller*).



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FIG. 327.—Panas' operation for entropion (*Meller*).

FIG. 327, 1.—After cutting through the skin (*s.*) and muscle (*m.*), the tarsus (*ta.*) and conjunctiva are incised, over an ivory plate placed between lid and bulb, along the entire length of the lid. The central suture has already been introduced. Above it is fastened the tarsus near the edge of the tarsal wound. Both ends of the suture pass downward between tarsus and muscle and emerge in the intermarginal border behind the cilia. One end of the suture a glass bead is drawn.

FIG. 327, 2.—Sagittal section through the upper lid after completion of the operation. The margin of the lid, now placed vertically to the plane of the lid, is so adjusted to the tarsus (*ta.*) that no part of it projects into the palpebral fissure; in fact, only a small portion of the wound-surface (the cut edge (*c.*) of the tarsus) remains exposed (*Meller*).

continuous wet compresses should be applied. These procedures should be continued until the time of operation, when the surrounding skin washed thoroughly with ether or benzin and then painted with one-third strength tincture of iodine to the mucocutaneous junction. Orechki is said to use two-thirds strength tincture of iodine inside the eye as well as on the skin. This seems to be a very heroic procedure, inasmuch as all unnecessary irritation of the conjunctiva should be avoided when operating on the lids.

Anesthesia.—Many of the minor procedures should be carried out under local anesthesia. If an extensive operation with complicated

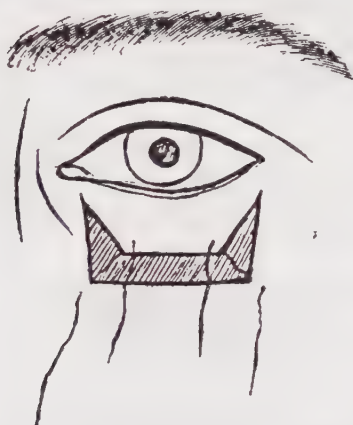


FIG. 328.—Panas' operation for entropion (Beard).



FIG. 329.—Graefe's operation for entropion (Beard).

FIG. 328.—A vertical incision about 1. cm. ($\frac{3}{8}$ inch) long is made through the skin muscle below each canthus. These are joined by a horizontal incision through the skin only, and the flap is dissected up to the lid margin. A strip of the premarginal portion of the orbicularis muscle is excised. The desired amount of skin is removed from the end of the flap, and the wound is closed.

FIG. 329.—An incision is made through the skin and muscle the length of the lid, 0.3 ($\frac{1}{8}$ inch) below and parallel to it. A triangle of skin of the desired size is removed. The skin and muscle along the margin is raised and the muscle is removed. The dotted triangle indicates the outline of the incision for the removal of the tarsus, if necessary. The skin flaps are undermined and the wound is sutured.

flaps is planned, it is advisable to use a general anesthetic, as the infiltration would distort the tissues and make the proper flap outline difficult to calculate.

Suture Material.—In operating on the lids I prefer horsehair for all the skin sutures and very fine silk (oiled or vaselined) for the margins or the conjunctiva.

Dressings.—A drop of sterile castor oil instilled into the eye before and after operating, is very efficacious in diminishing the amount of the resulting irritation.

Before the dressing is placed care should be taken that no stitch and is left between the lids; the neglect of this precaution has often aused much needless discomfort.



FIG. 330.—Bilateral contracture following a burn, with partial ectropion of both lids, preventing closure. Duration seven years.—1. The lids cannot be closed more than is shown in the photograph. When asleep the eyeballs are rolled upward. 2. Twenty months after the relief of the contracture and transplantation of whole-thickness grafts to the upper and lower lids of both eyes. Note the perfect closure. The alæ have also been repaired.

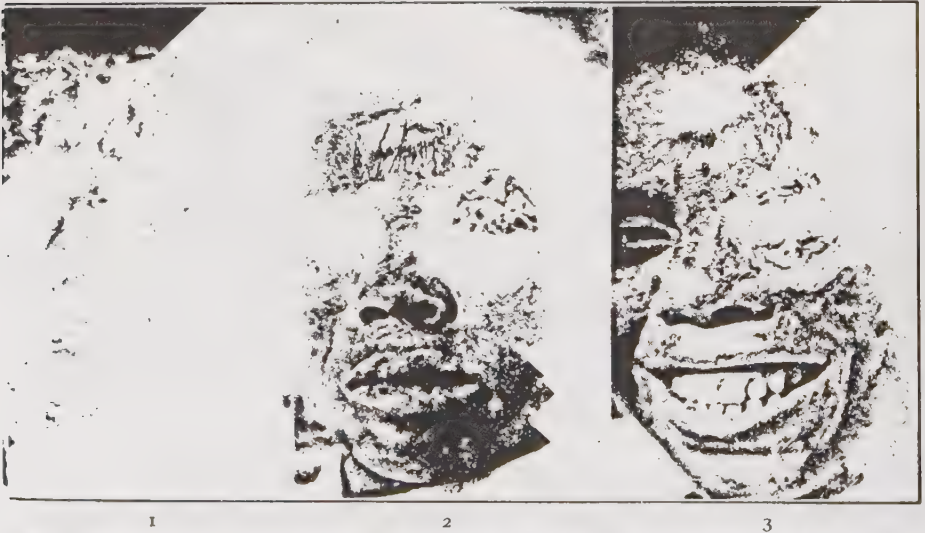


FIG. 331.—Ectropion of both lids of the left eye following a burn twelve years before admission. 1. Note the opacity of the cornea, and the extensive scarring of the forehead and cheek. 2. Three weeks after releasing the upper lid and transplanting a whole-thickness graft from the arm. 3. Three months after transplantation to the upper lid, and one month after the transplantation of a whole-thickness graft into the lower lid. The condition of the left eye improved so rapidly after the formation of the lids that light and darkness could be distinguished, and it was decided not to enucleate the eye.

A smear of yellow oxid of mercury ointment (gr. $\frac{1}{2}$ to the dram of vaselin) along the lids is used before the dressing is applied. Over

this are placed several layers of gauze wet with normal salt solution and then wet cotton, all being secured with a bandage. The dressing may or may not be kept wet, as seems desirable. Both eyes should be included in the dressing for the first day at least.

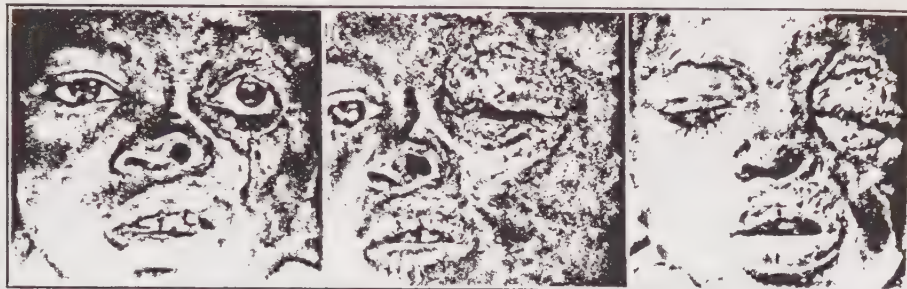


FIG. 332.—Unilateral ectropion of both eyelids following a burn. Duration two and one-half years.—1. Note the involvement of the left cheek, side of the face and the ectropion of both eyelids. 2 and 3. Ten days after release of the lids and implantation whole-thickness grafts above and below.

ENTROPION (INVERSION OF THE EYELID)

The majority of these cases which come under the care of the plastic surgeon are of the cicatricial variety following severe burns and a



FIG. 333.—Unilateral ectropion of both eyelids, *continued*.—1 and 2. Taken ten months after grafting. In the meantime one or two operations were done to lower the left side of the mouth and to reconstruct the left ala. 3. Condition two years after operation. The eyelids can be closed but further improvement can be made. The presence of scar prevented the use of a flap of neighboring skin in this case. However a flap from the neck might have been used.

associated with other contractures. The tarsus is warped and thickened and the conjunctiva is atrophied. This condition is much less common than ectropion.

Numerous operations have been described for the relief of the

condition; in my experience the deformity is difficult to correct and no method can be depended upon.

The appended diagrams of the Hotz-Anagnostakis, Snellen, Panas, and Graefe's procedures are self-explanatory (Figs. 321-329).

ECTROPION (EVERSION OF THE EYELID)

Cicatricial ectropion is due to contracture of the skin following burns, or other forms of ulceration.

Ectropion may be treated: (1) By *skin grafting*; (2) by *sliding flaps* (French method); (3) by *pedunculated flaps from adjacent tissue* (Indian method); (4) by *pedunculated flaps from distant parts* (Italian method).

1. **The Use of Whole-thickness Skin Grafts** (the original operation of Wolfe).

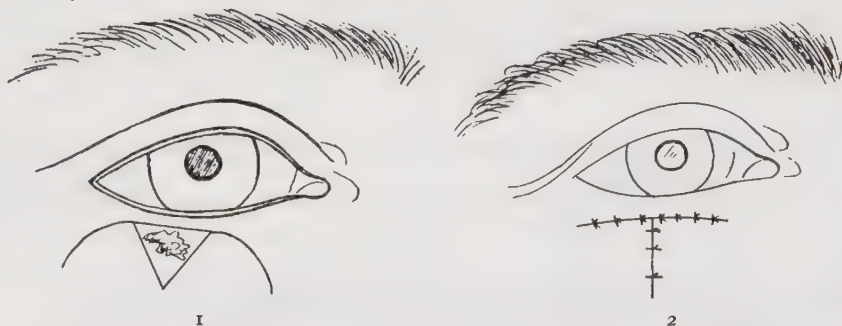


FIG. 334.—Dieffenbach's operation for ectropion (*Beard*).—1. The dark lines indicate the incisions. 2. After removal of the scar the lateral flaps are undercut, shifted inward and sutured.

The scar tissue on either the upper or lower eyelids is excised as completely as possible and the lid is mobilized. The palpebral margins are held together with several sutures or, better still, one is drawn over the other and secured with sutures and a graft of whole-thickness skin is fitted into the defect and secured with interrupted sutures. Immobilization is important for a few days at least.

The skin is best obtained from the inner side of the upper arm where it is hairless and thin, or from the prepuce. I have had some excellent results with this method.

The use of Ollier-Thiersch grafts, or small deep grafts, is not to be advised in these cases, as the contracture that usually follows will cause at least a partial recurrence.

2. By Sliding Flaps :

Operation of Dieffenbach.—Three straight incisions are made around the adjacent scar in the form of a triangle, with its base near

and parallel to the margin of the lid. This area is excised, and two slightly curved incisions are then made from the corners of the base of the triangle, after which the skin is undermined. The skin on the upper side of the entire incision is dissected up, the lid is placed in normal position, and the edges are sutured, forming the letter Z (Fig. 334).

This operation can be used only for small lesions on the lower lid

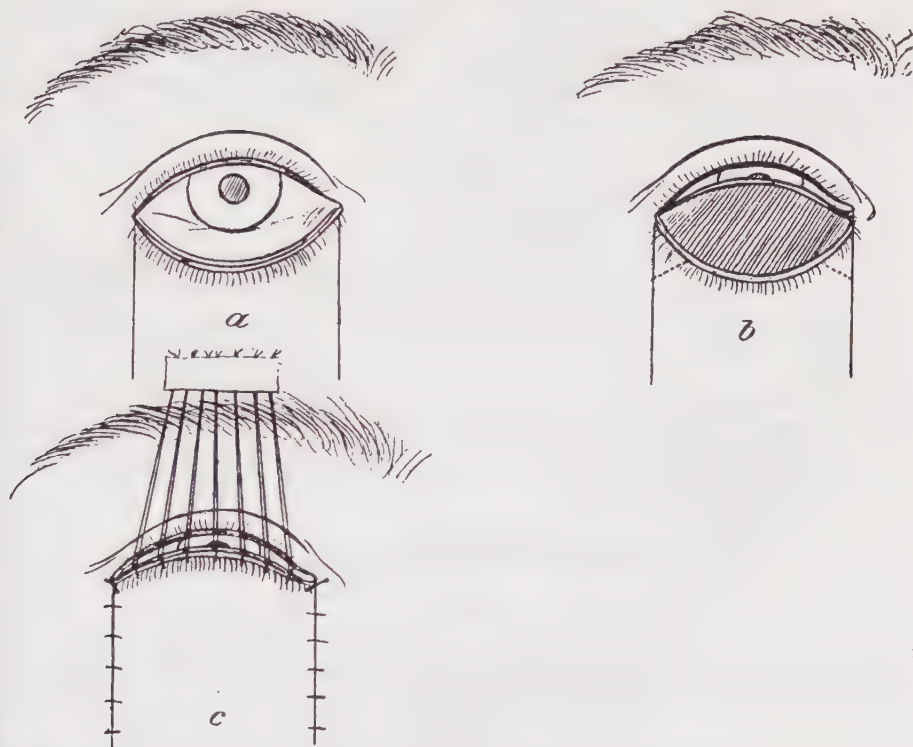


FIG. 335.—Graefe's operation for cicatricial ectropion (*Beard*).—*a*. The dark line indicates the incisions splitting the lid for its entire length into two leaves. *b*. The inner leaf of tarsus and conjunctiva is turned upward. The dotted lines indicate the portion of the outer leaf of skin and muscle which are removed. *c*. The outer leaf is shifted upward to cover the inner, and held in an over-corrected position by sutures which are secured to the forehead.

Operation of von Graefe.—An incision is made along the border of the lid from the inner to the outer canthus. From each end of this incision a perpendicular cut of the desired length is made and a flap of skin is separated from the tarsus. The ectropion is corrected and the upper edge of the flap is trimmed to fit the tarsal border. From both corners of the flap small pieces are excised, so that when it

utured, the skin will be drawn more tightly transversely. The sutures in the tarsal border are left long and are fastened to the forehead with adhesive plaster or collodion and gauze. In this way overcorrection is obtained until the healing is well started (Fig. 335).

This operation can be used for extensive ectropion of the lower lid.

Operation of Wharton Jones.—From a point near each commissure two converging incisions are made to include the scar and meet beyond the shape of the letter V. The triangular flap is dissected up to the root of the cilia and the surrounding skin is undermined. The lid is then pushed up and overcorrected and the edges are sutured to form Y (Fig. 336).

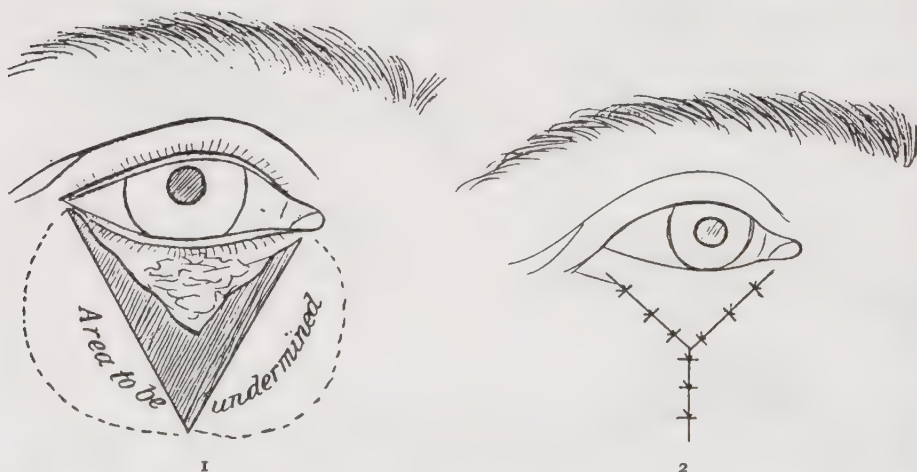


FIG. 336.—Wharton Jones' operation for ectropion (*Beard*).—1. A V-shaped incision is made; the eyelid is released by undercutting the flap; the surrounding skin is undermined. The skin edges are sutured in the shape of a Y.

This very useful operation is designed for either lid, but in my hands has not been satisfactory on the upper. The same procedure is used for ectropion of the lip.

In severe cases of long standing, in addition to the operations described for cicatricial ectropion, it is often necessary to shorten the free border of the lid in order to remove the excess tissue. This may be done by the methods used for atonic ectropion, and can be readily followed on the diagrams of the operations of Adams, von Ammon, and Kuhnt (Figs. 337-339).

The operations just mentioned are for the relief of ectropion alone and cannot be used for the formation of a new eyelid.

The Flap-sliding Operation of Dieffenbach.—In excising the defective tissue on the lower lid a triangular gap is made, with its base upward. Care should be taken to preserve all healthy conjunctiva. A horizontal incision is made outward from the angle of the gap close

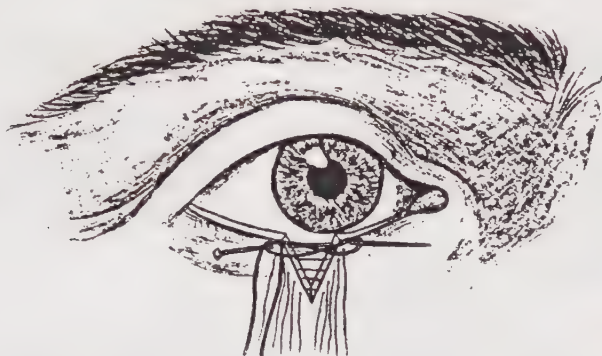


FIG. 337.—Adams' operation for atonic ectropion (*Beard*).

A wedge, including skin, tarsus and conjunctiva is excised from the center of the lid, and the edges are sutured. The central scar is undesirable.

to the canthus. This should be long enough to make a flap sufficient wide to fill the opening. A second incision is made from the outer end of the horizontal cut parallel to and of the same length as the outer



FIG. 338.—Von Amon's modification of Adams' operation for ectropion (*Beard*).

A wedge, including skin, tarsus and conjunctiva is excised from the outer canthus and the edges are sutured.

border of the triangle. The flap thus made is dissected up and slid inward to fill the triangular defect and sutured into place. By undercutting the surrounding skin a considerable portion of the defect can be closed by raising the flap can be sutured. The part that cannot be closed

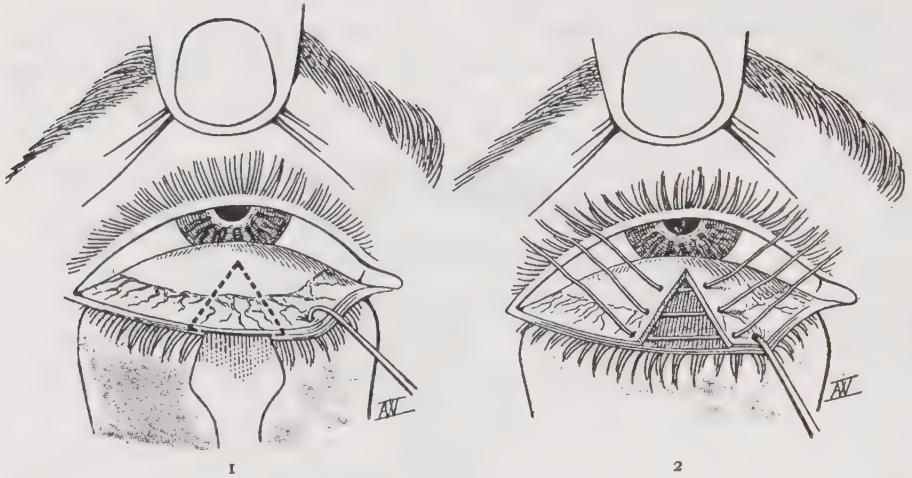


FIG. 339.—Kuhnt's operation for atonic ectropion (*Beard*).—1 and 2. A triangle of tarsus with its overlying conjunctiva is excised without including the skin. The edges are sutured on the inside. There will be a redundant fold of skin on the surface which may be removed after shrinkage has ceased.



FIG. 340.—A combination of Kuhnt's and Dieffenbach's operations for ectropion of the lower lid (*Beard, in Wood*).—1. A wedge of conjunctiva and tarsus removed from the center of the lid. Also a triangular area of skin removed from beyond the outer angle, as shown in the diagram. 2. The tarsal wound is closed, and the flap raised from the lower lid is shifted outward and sutured to fill the defect.



FIG. 341.—The Argyle Robertson strap operation for ectropion (especially of the outer half of the lower lid) (*Beard, in Wood*).—1. The dotted lines indicate the incisions. To shorten the lid remove a wedge-shaped area of skin, tarsus and conjunctiva a short distance from the outer canthus. Then the flap of skin as outlined is raised and the ectropion is corrected. 2. The overlapping end of the flap is removed, and the wounds are sutured.

should either be skin grafted, or be filled with a pedunculated or sliding flap from the forehead or temple as, for example, in Harlan's operation

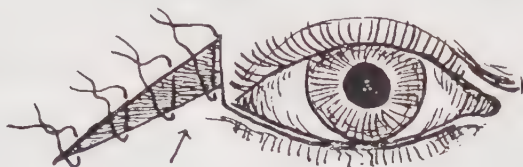


FIG. 342.—Kuhnt's operation for ectropion of the lower lid (*Beard, in Wood*).—A elongated triangular area of skin is removed as shown in the diagram. An incision is made along the lid margin inside of the cilia, and the flap is loosened. Closure of the skin defect shortens the skin along the lower lid. This can be used in conjunction with Kuhnt's operation of excision of a wedge of the tarsus and conjunctiva.

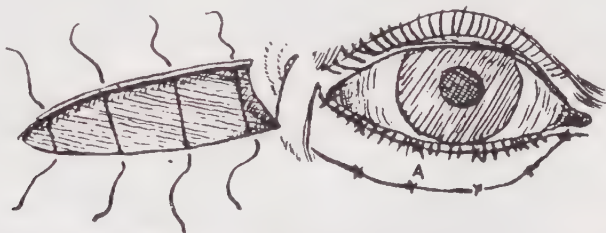


FIG. 343.—Truc's operation for ectropion (*Beard, in Wood*).—A pedunculated flap of skin sufficiently long is raised from the forehead external to the eye. It is turned around under the loop of skin as shown, to fill the defect left by relieving the ectropion. This closes the defect and at the same time supports the lid. The pedicle is cut ten days later.

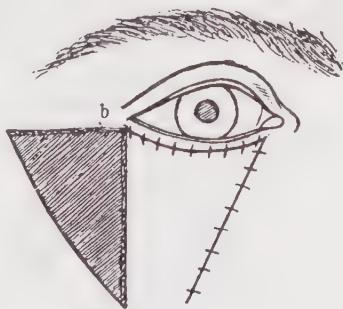
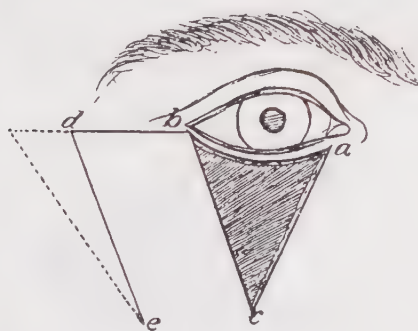


FIG. 344.—Dieffenbach's blepharoplasty in the removal of a growth. * It can also be used in ectropion (*Beard*).—1. The shaded area *abc* indicates the defect left by the excision. The dark lines *bd* and *dc* show the outline of the lateral flaps which are shifted toward the midline to cover the defect. The dotted line shows the area to be undermined in reducing the size of the surrounding defect. 2. The flap shifted inward and sutured into the defect. The remaining raw surface should be grafted.

This is an excellent method, and with modifications can be used in many situations, especially on the lips (Figs. 344, 345 and 346).

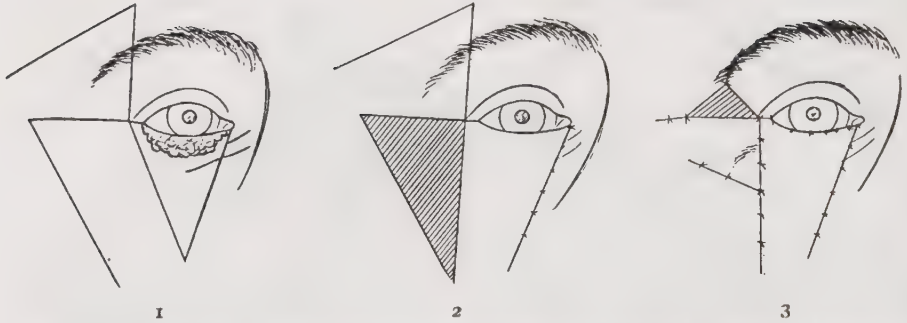


FIG. 345.—Harlan's modification of Dieffenbach's flap sliding operation (*Beard*).—1. The dark lines indicate the incisions. 2. The V-shaped wedge of skin with the growth has been removed. The external flap has been shifted in to cover the defect, leaving a triangular defect. 3. By undercutting the skin edge and suturing, and by sliding down the upper flap the triangular defect is closed, leaving a small uncovered area at the outer angle of the eye, which may be grafted.

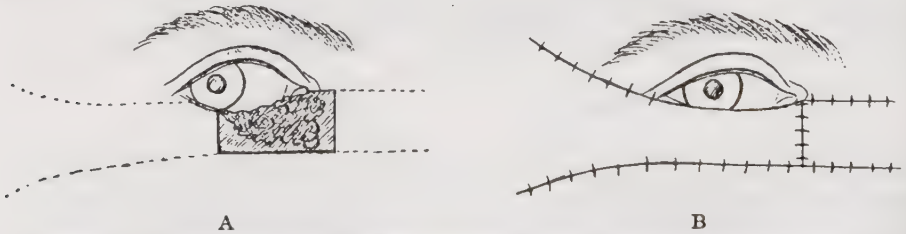


FIG. 346.—Knapp's flap sliding operation for the repair of a quadrangular defect of the lower lid (*Beard*).—A. The shaded area indicates the extent of the excision. The dotted lines show the incisions outlining the flaps. B. The flap shifted inward and sutured. Care must be taken to have the flaps sufficiently wide, as the stretching may cause narrowing to such an extent that subsequent operations may be necessary to correct the deformity.



FIG. 347.—Tweedy's operation for ectropion (*Beard, in Wood*).—1. The dotted lines indicate the incisions. The flap A including a section of the conjunctiva and tarsus about 0.8 cm. (about $\frac{1}{3}$ inch) wide is raised. The ectropion is corrected by dissecting up the skin along the incision B. 2. The flap A is then shifted into this defect and sutured. If it is necessary to use the tip of mucosa on the end of the flap to close the defect, it can be removed subsequently.

The flap-sliding operation of Dieffenbach, Harlan's modification and Knapp's operation, may be used for the formation of a new lid as well as for the relief of ectropion, but in my opinion the section of the flap forming the lid itself should be lined with epithelium, if the full thickness of the lid is to be restored.

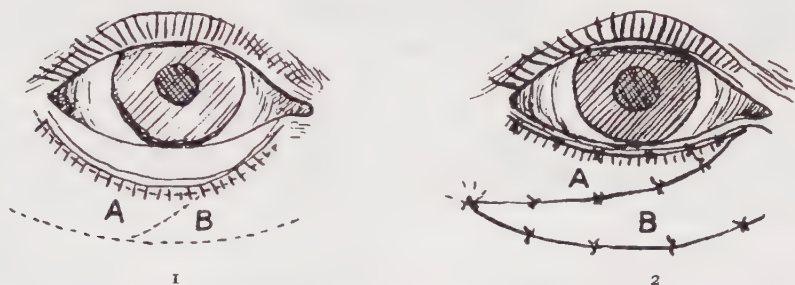


FIG. 348.—Lagleyze's operation for ectropion of the lower lid (*Beard, in Wood*).—1. The dotted lines mark the outlines of the flaps A and B. 2. After the flaps have been dissected up and the ectropion relieved they are superimposed and sutured in the position shown.

RESTORATION OF EYELIDS

The absence of the eyelids, in whole or in part, is due to direct trauma, to the excision of malignant growths, to destruction following disease, syphilis, tuberculosis, ulcer, gangrene.



FIG. 349.—Denonvilliers' operation for ectropion of the outer third of the lower lid (*Beard, in Wood*).—1. The dotted lines indicate the incisions to form the flaps A and B. 2. The flaps are dissected up. The ectropion is corrected and the flaps are transposed and sutured.

A number of operations have been devised for restoring the lid; among them Gibson's and Monks'.

Gibson's Operation.—An incision is made through the whole thickness of the skin from the external canthus, in an outward and slight upward direction. The length of this incision is determined by the

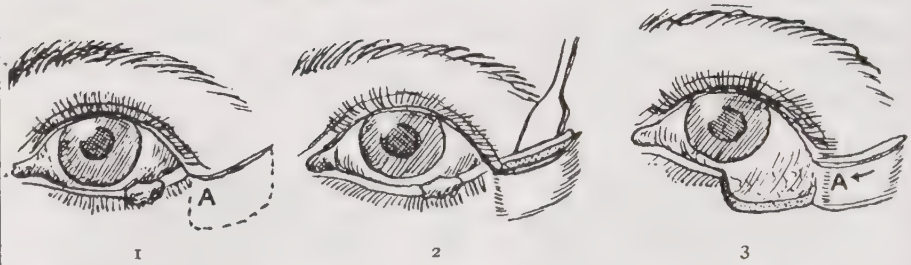


FIG. 350.—Gibson's operation for the restoration of the lower lid by the use of a pre-rafterd gliding flap (*Annals of Surgery*, June, 1914).—1. The area A outlined by the dotted line is undercut. 2. The pocket is lined with an Ollier-Thiersch graft, with its raw surface against the skin. 3. The growth has been excised. The flap A has been loosened by horizontal incisions.

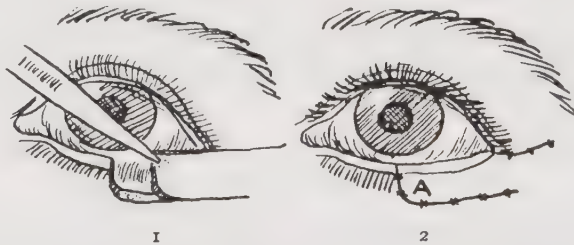


FIG. 351.—Gibson's operation, *continued*.—1. The lined flap being drawn inward to fill the defect. 2. The completed operation. In preparing such a flap it is important to plan for the narrowing which follows stretching.

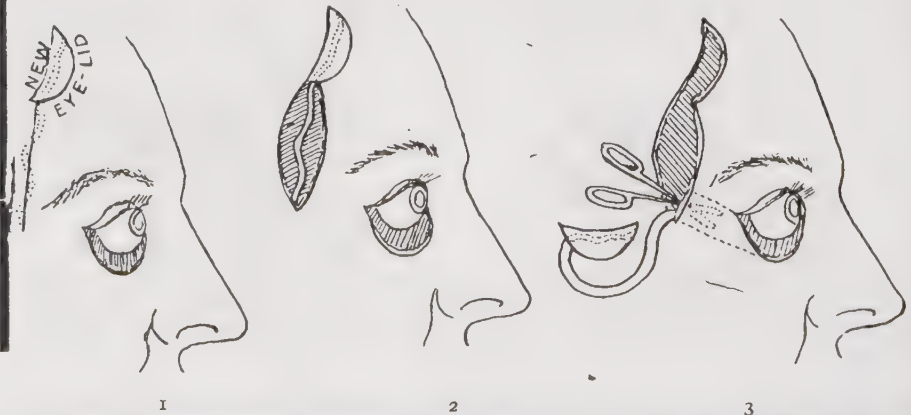


FIG. 352.—Restoration of an eyelid by the use of a flap whose pedicle consists of the anterior temporal vessels (*Monks*).—1. Defect in eyelid following excision of an epibelioma. The dark lines indicate the incisions outlining the flap and to expose the vessels. The anterior branch of the temporal artery is shown by the wavy dotted line. 2. The vessels exposed. 3. The flap dissected out with its blood-vessel pedicle. A tunnel is being made beneath the normal skin between the incision and the lid defect.

amount of eyelid to be removed. (For the operation described, in which half the lower eyelid was removed, an incision 4.375 cm. ($1\frac{3}{4}$ inches) long was used.) Through this incision the skin is undercut and:

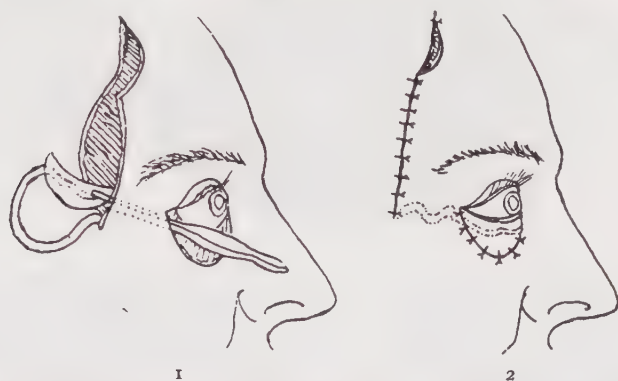


FIG. 353.—Monks' operation for the restoration of an eyelid, *continued*.—1. Drawing the flap through the tunnel. 2. The flap sutured into the defect and the incisions closed. The dotted lines indicate the position of the vessel pedicle, and of the vessels in the flap.

pocket is made, which has the outline of the proposed flap. The skin side of the pocket is lined with a single Ollier-Thiersch graft, which overlaps the edge. After ten days the growth is removed with the neces-

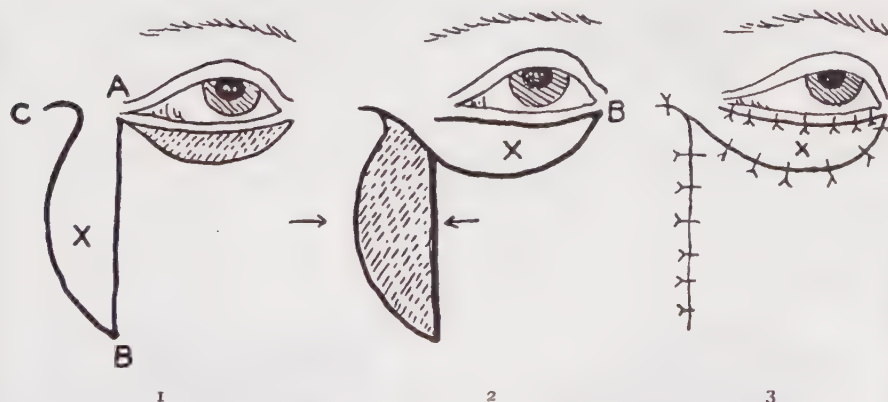


FIG. 354.—Operation for the restoration of the lower lid (Langenbeck).—1. The shaded area indicates the defect. The flap X is marked out by the dark lines. 2. The flap shifted into the defect. 3. The defect from which the flap was raised may often be sutured after undermining the adjacent skin.

sary amount of lower lid by a quadrilateral incision. The lined flap is loosened by an incision parallel to the original skin incision, and slid over the defect and sutured (Figs. 350 and 351).

Monks' Operation.—He constructed a lower lid with a careful

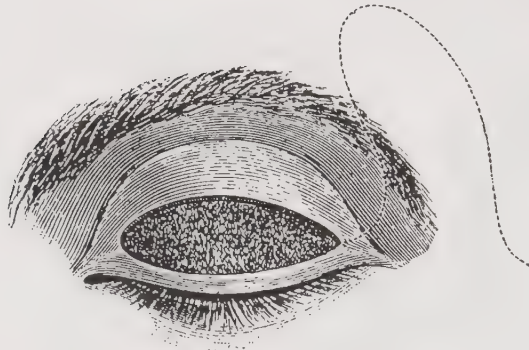


FIG. 355.—Fricke's operation for cicatricial ectropion of the upper lid (*Beard*).—This operation is especially adapted to cases in which the tarsus and the conjunctiva are intact. The ectropion has been relieved, leaving an oval raw area. The dotted line shows the outline of the flap. The skin between the defects after raising the flap should be removed sufficiently to receive the pedicle. The defect from which the flap is raised should be closed by undermining and suturing, or by skin grafting.



FIG. 356.—The flap *b* is taken from the nose and forehead for restoration of the lower lid. The greater part of the defect being on the inner side.

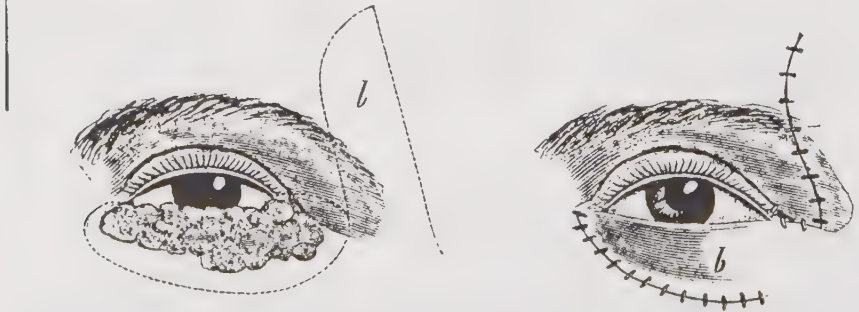


FIG. 357.—The same procedure with the flap from the outer side, and differently shaped to meet conditions.

FIGS. 356 AND 357.—Blasius' operations for the restoration of the eyelid (*Beard*).

measured flap from the forehead, whose pedicle consisted of the anterior branch of the temporal artery and vein with the surrounding sub-



FIG. 358.



FIG. 359.

FIGS. 358 AND 359.—Hasner's operations for the repair of an angular loss of substance, external or internal, by the use of a split or notched flap (*Beard*).—The dotted lines indicate the incisions outlining the flaps, and for the excision of the growth. The bifurcated flap *b* is raised from the outer or the inner side, depending on the situation of the loss of substance, and is transplanted and sutured as shown in the diagrams.

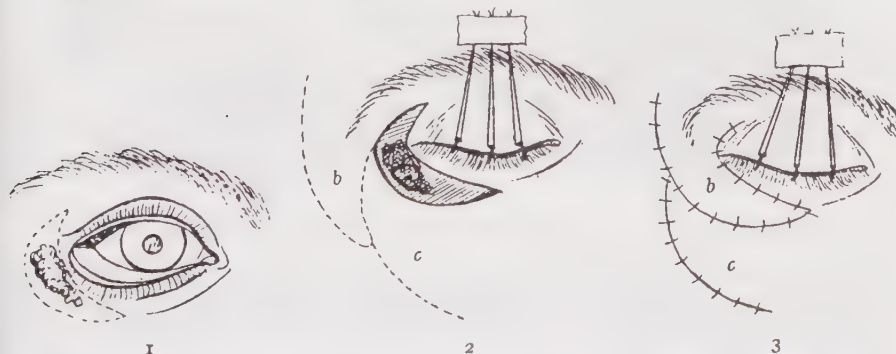


FIG. 360.—Richet's operation for the restoration of the commissure (*Beard*).—1. The dotted lines show the incision for removal of the growth. 2. Shows defect left by excision. The dotted lines indicate the outline of the flaps. The lower lid is drawn up over the upper lid, in an over-corrected position. 3. The flaps superimposed and sutured in position.

cutaneous tissues. The flap was brought into position by passing through a tunnel burrowed beneath the skin between the proximal and

of the pedicle and the defect. In finishing, all incisions are closed as far as possible (Figs. 352 and 353).

I would suggest that the under surface of the flap be pregrafted before transplanting, to avoid contracture, and that it be freely scarified when transplanted to reduce early congestion.

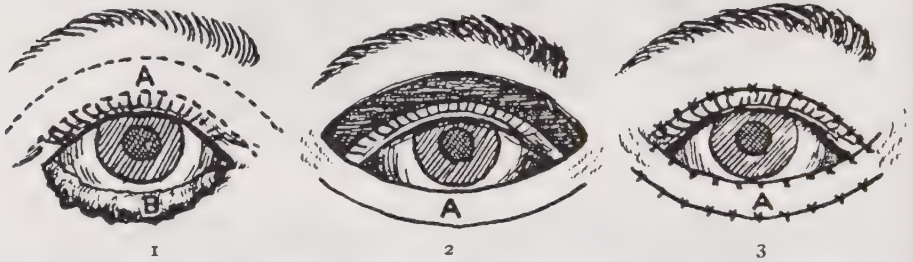


FIG. 361.—Landolt's double-pedicle flap for the restoration of the lower lid (*Beard, in Wood*).—1. The defect on lower lid B. The dotted lines outline the flap A. 2. The flap raised and shifted to cover the defect in the lower lid. Note the raw surface on the upper lid. 3. Flap sutured into position. The raw surface on the upper lid is closed. The pedicles are divided after ten days and fitted into position.

3. **By Pedunculated Flaps from Neighboring Skin.**—The principles of the use of pedunculated flaps have been considered in a previous section.

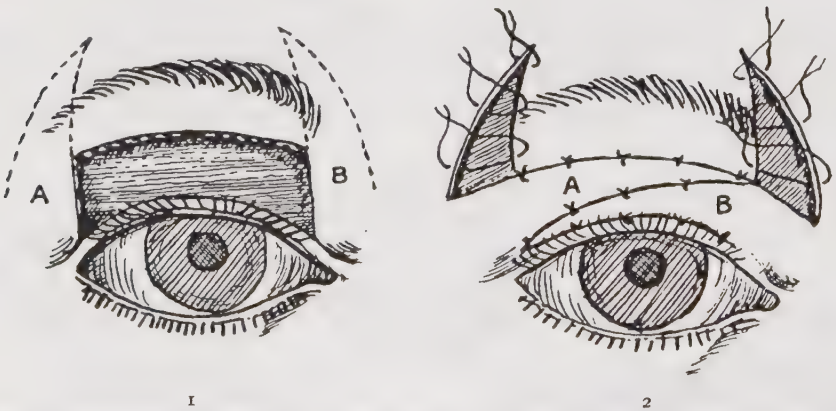


FIG. 362.—Rollet's operation for the restoration of the upper lid (*Beard, in Wood*).—1. The defect in the upper lid. The dotted lines mark the incisions for the flaps A and B. 2. The flaps are raised, turned inward and are superimposed. The defects left by raising the flaps may be sutured.

The use of this method by Fricke, Blasius, Hasner, Richet, Landolt, and others, will not be described in detail, the plates being sufficiently explanatory.

4. **Pedunculated Flaps from Distant Parts.**—Eyelids have been formed from pedunculated flaps from the arm (Berger and others), and neck (Syndacker-Morax, and others). By the use of these flaps

scarring of the face is avoided and normal tissue is secured in those cases in which the face is covered with scar.

Pedunculated flaps of this type may be used for the relief of ectropion, when the tarsal cartilage and conjunctiva are present, and also for the restoration of the lids. In the latter case it is essential that the flaps be lined with epithelium to prevent subsequent adhesion and contracture. This can be accomplished either by turning the end of the flap on itself (which makes a thick and clumsy flap), or by preliminary grafting of the raw surface of the flap.

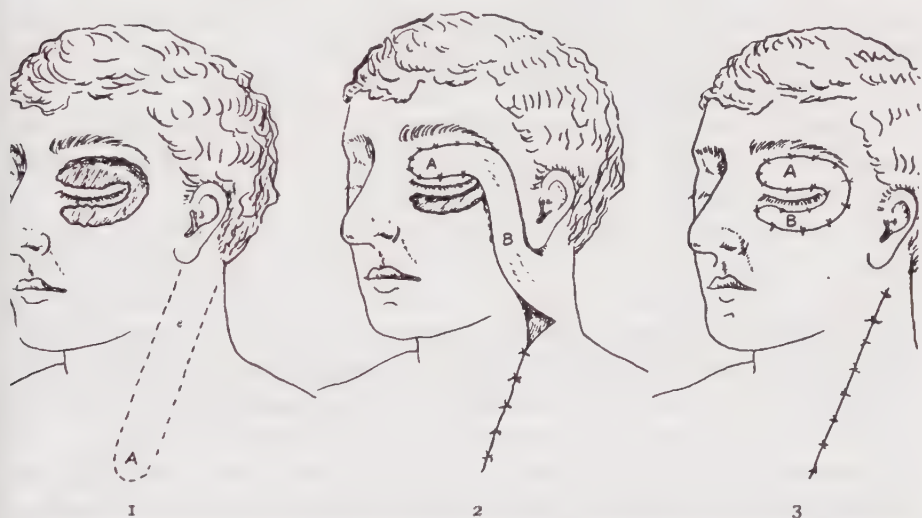


FIG. 363.—Syndacker-Morax method of utilizing a pedunculated flap from the neck for the restoration of one (Syndacker) or both (Morax) eyelids (*Beard, in Wood*).—1. The outline of the flap with its base beneath the ears to be raised from the skin over the sternocleidomastoid muscle. It should be sufficiently long to cover the lid defect without tension. Note the defect nearly encircling the eye. 2. The flap raised and sutured into the upper lid defect. The neck wound is sutured. 3. The pedicle of the flap is severed after two weeks, and the unattached portion of the flap is adjusted and sutured into the rest of the defect.

The ideal lining of these flaps would be mucous membrane, but yet no satisfactory technic has been developed for its use. It is possible that the application of a flap of buccal or vaginal mucosa placed in pocket in some such way as is described in Gibson's operation, might be worth trying. In any case, the result of thin Ollier-Thiersch grafting is so good and the epithelium adjusts itself to its new environment so promptly, that the more uncertain procedure of mucous membrane grafting seems unnecessary.

In all cases the area from which the flap is raised should be either sutured or grafted.

PREPARATION OF NEW SOCKET FOR AN ARTIFICIAL EYE

The object at which we aim when an eye is enucleated aseptically, is to prepare a movable stump on which the artificial eye can rest and move in coördination with the normal eye. This is best accomplished by implanting free fat in Tenon's capsule (at the time of enucleation), by Barraquer's method or some modification of it.

Sometimes infection will occur, or the eye may be destroyed by trauma or disease, so that the proper preparation for the artificial eye becomes impossible. In these cases the orbital cavity behind the lids may be obliterated by scar and the lids become adherent.

On several occasions I have been asked to prepare a cavity for the reception of an artificial eye in such cases. This is always a difficult task and many trials may be necessary.

The most satisfactory results in my hands have been obtained after freeing the lids) by excavating a cavity somewhat larger than the eye to be inserted. Then line this cavity with Ollier-Thiersch grafts, which are anchored here and there with fine silk sutures; then an eye similar to, but of larger size than that to be worn permanently which has been previously rendered aseptic) is inserted to splint the grafts, the lids are closed with sutures, and a dressing is applied.

Another method is to cover an artificial eye with a single Ollier-Thiersch graft, raw side out, secured by sutures, and insert it into the cavity. The artificial eye in both methods is not removed for at least one week, and preferably for ten days. It is then taken out with great care and cleaned. The stitches are removed, and after gentle irrigation of the graft lined cavity with normal salt solution, the same eye is again inserted. The cavity after grafting may be filled with melted paraffin, and the same post-operative routine carried out, but my preference is for the glass eye. After three weeks the normal sized eye is inserted, and except for daily cleaning is kept in place continuously for six weeks, after which the usual routine of nightly removal is commenced.

CANTHOPLASTY (LENGTHENING THE PALPEBRAL OPENING)

Canthoplasty is a very important procedure (either primary or secondary), in many of the plastic operations on the lid; it has for its object the lengthening of the outer commissure.

Agnew's Operation. (Modification of von Ammon's Operation.)—With strong scissors the outer commissure is lengthened for from 1. to 1.5. cm. ($\frac{2}{5}$ to $\frac{3}{5}$ inch). The canthal ligament (above and below) is divided with very fine scissors. A needle is placed in the conjunctiva

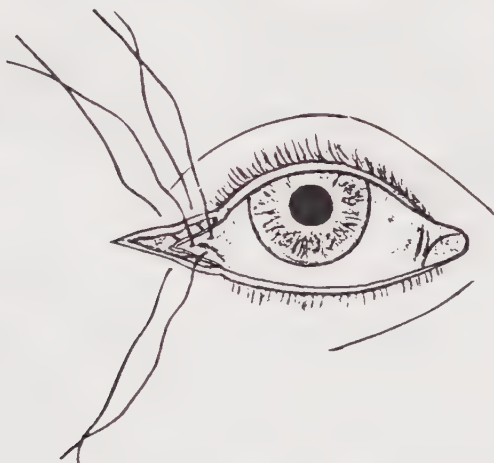


FIG. 364.—Von Ammon-Agnew's operation for canthoplasty (*Beard*).—The palpebral fissure has been lengthened, and the external canthal ligament divided. Note the position of the sutures so placed that they prevent stretching of the conjunctiva, and obliteration of the external cul-de-sac.

angle and is carried outward as far as it will go without stretching the conjunctiva, and is passed through the upper lip of the wound (not the external angle of the skin incision, if it would cause too much tension).



FIG. 365.—Abnormal narrowing of the palpebral slit.—1. Before operation. The history of the case is that the lids were united at birth, but were opened slightly during infancy. 2. After operation. The canthi were lengthened externally and internally, and an elongated ellipse of skin was removed from between the eyes. The lid muscles were atrophied from lack of use, but later the patient was able to open the lids more widely. Photograph taken three months after operation.

sion). Another suture above and below join skin and mucous membrane, and the operation is finished with a single skin stitch if necessary (Fig. 364).

TARSORRHAPHY (SHORTENING THE PALPEBRAL OPENING)

Tarsorrhaphy is an operation designed to shorten the palpebral fissure; in plastic surgery this procedure is sometimes necessary in dealing with extensive ectropion.

Walther's Operation.—Strips of skin are excised from the margins of both upper and lower lids, deep enough to include the follicles of cilia. These denudations should extend as far from the canthus as is rendered necessary by the degree of closure desired. The raw edges are united with rough and through sutures, which are allowed to remain for four or five days (Fig. 366).

INTERNAL TARSORRHAPHY is seldom necessary in plastic surgery.

EXENTERATION OF THE ORBIT

Occasionally it is necessary to remove the lids and entire contents of the orbital cavity including the periosteum (or malignant disease). In these cases, unless something is done to fill this cavity, the contraction of the scar due to gradual healing by cicatrization will pull all the surrounding soft parts into the defect—a result that will cause great discomfort and hideous deformity.

The immediate treatment is either to line the cavity with Ollier-hirsch grafts, which is usually very unsatisfactory, or to shift in pedunculated flaps from the forehead or cheek.

The cavity may be filled with a free fat graft, and covered with a pedunculated flap from the forehead (Schirmer). The method of utilizing flaps from the forehead, although they often will close the defect, has the disadvantage of leaving extensive unsightly scars, and this, of course, should always be avoided as far as possible in plastic work on the face.

The best procedure is to fill the orbit with a thick pad of fat covered with whole-thickness skin. This is done by the use of a pedunculated flap, and a double transfer is usually necessary, since we can seldom get a sufficiently thick pad of fat from the arm.

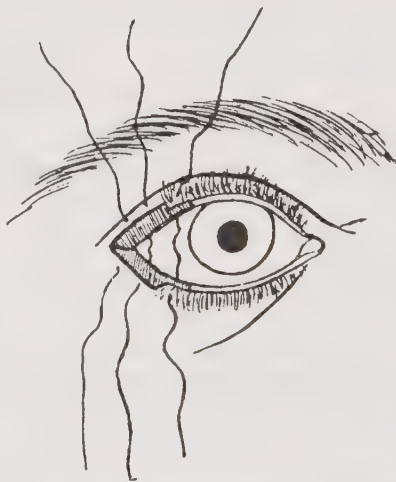


FIG. 366.—Walther's operation for external tarsorrhaphy (Beard).—The shaded area indicates the denuded portion of the lids.

The method I have used is to implant the edge of a pedunculated flap of fat and skin from the abdominal wall as thick as is possible to raise, into an incision in the palm of the hand. After the circulation

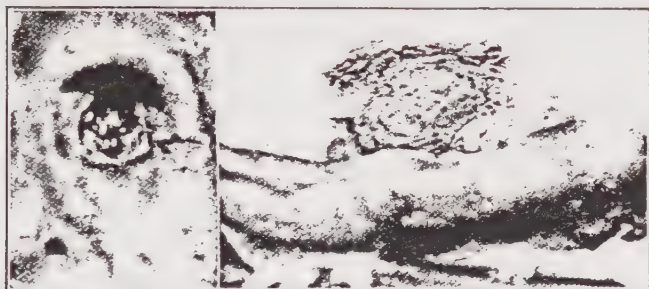


FIG. 367.—Method of dealing with exenteration of the orbit, including removal of the lids. The defect followed the removal of a melanotic sarcoma.—1. Note the deep cavity covered with granulations and the surrounding skin being drawn in over the orbital margins. This caused intense discomfort. The problem of checking the pull of the skin in the orbital cavity and at the same time filling the cavity had to be considered. A flap from the neck or forehead could have been used, but this procedure entailed a disfiguring scar which should always be avoided if possible. It was decided to attempt to fill the cavity by means of a pedunculated flap from the abdomen with a double transfer. 2. A flap composed of the skin and full thickness of the abdominal fat was implanted into an incision along the ulna side of the hand. After two weeks the pedicle was cut and the result is shown in the photograph. Two weeks later, during which time all ill-nourished portions were removed, the eye defect was prepared and, after proper shaping, the flap was implanted into the orbital cavity, and about two-thirds of the skin margin was sutured.

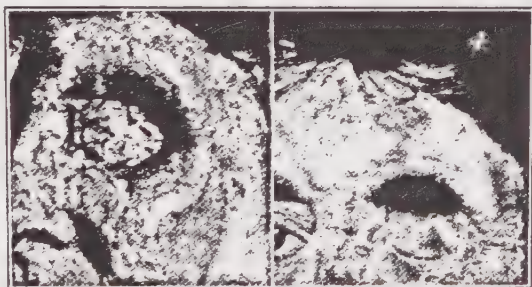


FIG. 368.—Exenteration of the orbit, *continued*.—1. After ten days the flap was away from the hand, and the remaining portion was fitted into position. The photograph was taken one week after this and shows some of the stitches in the portion last sutured. 2. Taken one year later. There has been shrinkage of the fat, but the skin is soft and movable and all tendency to puckering and drawing in of the face skin has been eliminated and there is no discomfort. The age of the patient contraindicated any attempt to remove the lids and prepare a socket for an artificial eye.

has been established from the palm to the flap, to amputate from the abdominal wall, then shape the fat and transfer the flap on the hand to the defect in the orbit, which has been prepared to receive it, and

ture the skin edges to the surrounding skin. In due time (from ten to fourteen days) the flap is cut away from the hand and the rest of the defect is closed (Figs. 367 and 368).

This gives a result which prevents further contracture and makes the patient comfortable. A certain amount of the fat of the flap may appear, but even so the result is satisfactory to the patient.

If further padding is needed after healing is complete, the skin may be undermined and a free fat graft inserted.

RESTORATION OF THE EYEBROW

A missing eyebrow may be restored: (1) **By the free transplantation of whole-thickness hair-bearing skin**, from the pubes or from the

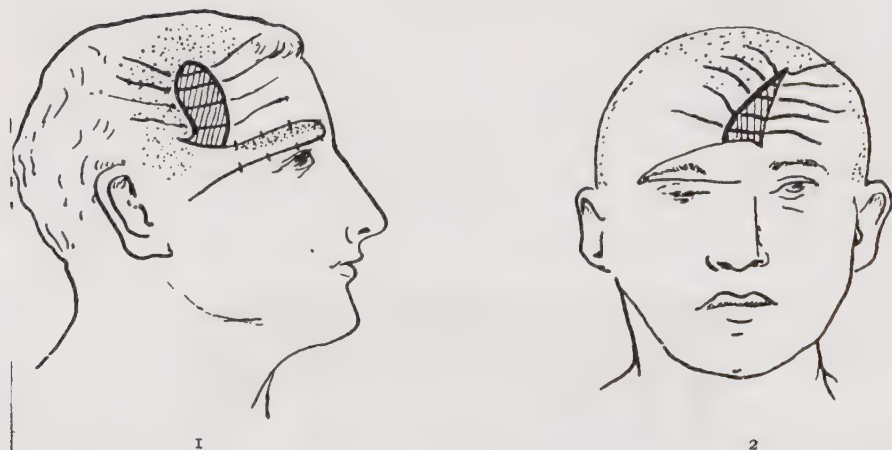


Fig. 369.—Methods of reconstructing eyebrows.—1. By means of a temporal flap. 2. By means of a frontal flap (*Morestin*).

scalp. I have used this method with success, and enough hair follicles have survived to make the result worth while. In planning the graft "the set" of the hair must be taken into consideration. The technique that used for any whole-thickness graft.

(2) **By using pedunculated flaps of hair-bearing skin**, from the scalp or from the hairy portion of the forearm. Pedunculated flaps from the scalp are easily obtained either from the frontal or temporal regions, and may be turned into the defect without difficulty. The location from which the hairy portion is raised depends on the hair type, which is much closer to the eyebrows in some instances than in others. The flap may be turned directly into the defect, or its pedicle

may bridge normal skin. Hairless skin from the forehead may be included in the flap if necessary to repair defects in the upper lip (Fig. 369).

Secondary operations are always necessary to shape the eyebrow, in order to remove any excess of hair-bearing skin, and to smooth out any kink in the pedicle. Little scarring is noticeable, as the hair conceals the scalp scar, and the scar on the forehead can be made quite inconspicuous.

A pedunculated flap from the forearm of a hairy individual can be transplanted by the Italian method. The utilization of this method depends on the hairiness of the skin, and thus limits its applicability. Secondary trimming operations may be necessary after amputation of the pedicle.



FIG. 370.—Goyanes' operation for restoration of an eyebrow (*Beard*).—1. Dotted lines mark the incisions made to form the pedunculated flap B. The area A has been properly prepared for the reception of the flap. 2. Shows the flap consisting of half of the normal eyebrow sutured into its new position, and all wounds closed.

Both of these pedunculated flap methods are rational and give good results.

(3) **By Splitting the Intact Eyebrow in Half and Transplanting It as a Pedunculated Flap** (Goyanes).—I have used this method with success. The flap should be as thick as possible, as it is so narrow at its extremity that the blood supply may be insufficient. The scars are inconspicuous (Fig. 370).

Ptosis

Ptosis of the eyelid is of interest to the plastic surgeon, since it may be due to redundancy of tissue after other plastic operations. In these instances simple excision of the slack skin and, if necessary, of an ellipse of tarsal cartilage, with proper closure, is usually sufficient to correct the deformity.

The many complicated operations which have been devised for the relief of congenital and paralytic ptosis, will not be considered

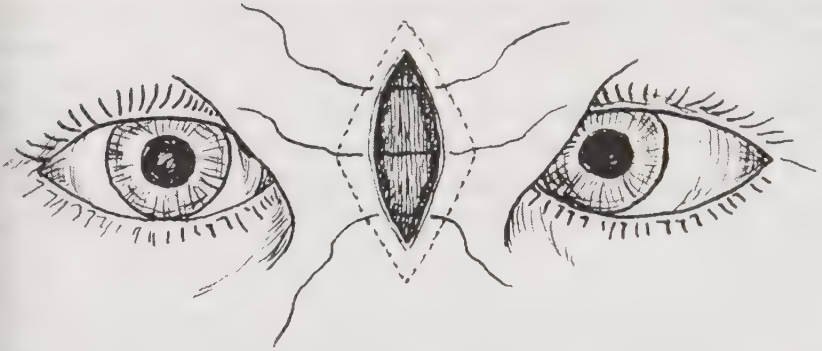


FIG. 371.—Knapp's operation (modified v. Ammon) for epicanthus.—An ellipse or almond-shaped piece of skin is excised from the bridge of the nose. The skin is undermined and the edges are closed.

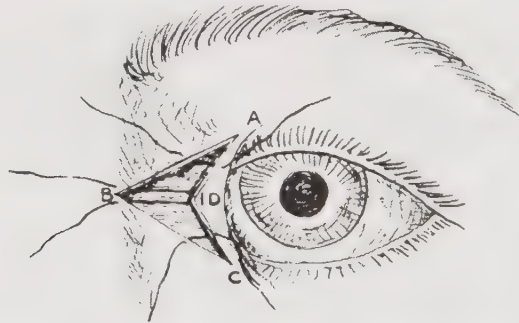


FIG. 372.—Operation for epicanthus (*Berger*).—An incision is made from the upper, and also the lower parts of the fold, to a point on the nose in line with the inner canthus, thus making a V-incision. From the ends of this incision two others are made which converge at a greater angle than the preceding, thus marking out the area ABCD, which is excised. The edges are then drawn together.

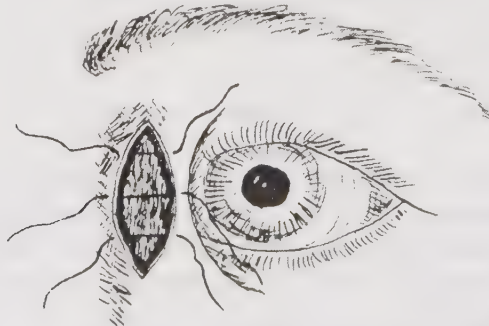


FIG. 373.—Operation for epicanthus (*Desmarres*).—An ellipse of skin is excised on each side of the nose, and the skin is closed with sutures.

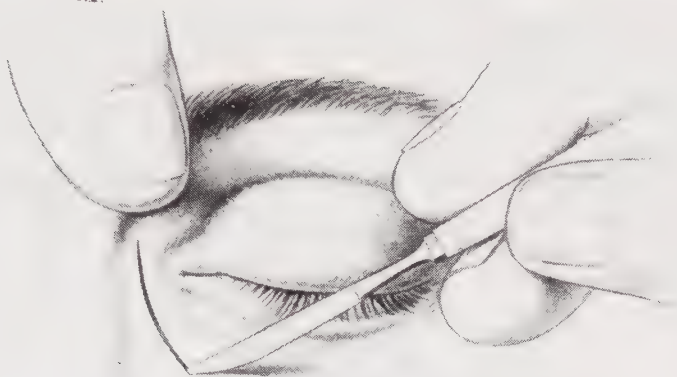
l.th.

FIG. 374.—Excision of the lachrymal sac.—With the thumb of the left hand the skin fixed, but not pulled or stretched. The cutting edge of the knife is directed vertically against the bone. The incision is downward, slightly outward and somewhat curved 0.3 cm. to 0.4 cm. ($\frac{1}{8}$ to $\frac{1}{6}$ inch) distant from internal canthus (*Meller*).

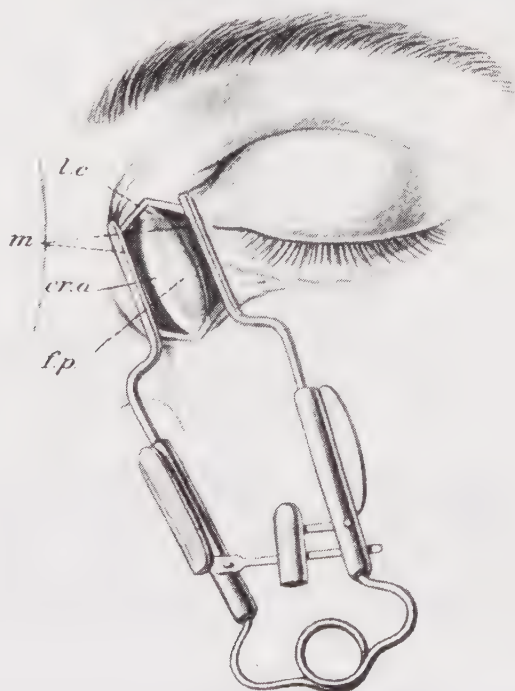


FIG. 375.—The separation and pulling to either side of the muscle-fibers (*m.*) expose the deep fascia (*f.p.*) in the wound; behind this the sac must be looked for.—In the upper angle of the wound are the transverse fibers of the ligament of the internal canthus (*l.*). Through the fascia the anterior lachrymal crest (*cr.a.*) can always be felt and can occasionally be seen (*Meller*).

ere. For detailed information on this subject the reader is referred to works on Ophthalmic Surgery.

Epicanthus

Epicanthus is a congenital deformity in which a fold of skin partly covers the inner canthus. It may be corrected by Knapp's, Des-

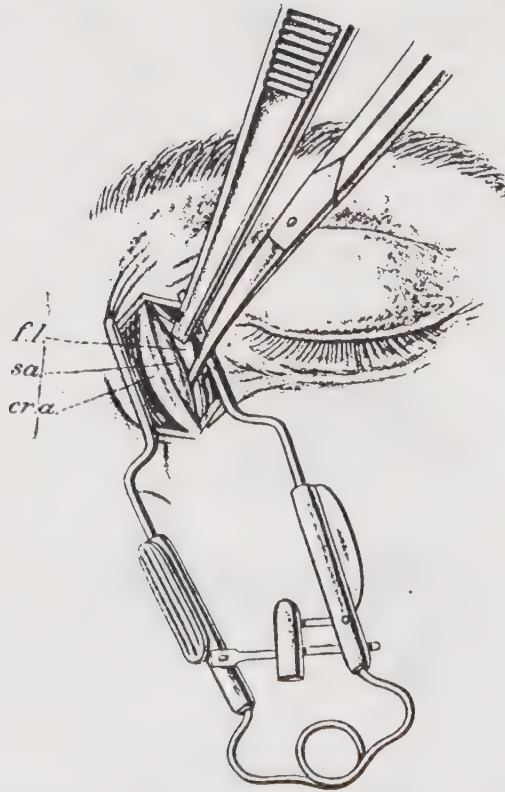


FIG. 376.—The deep fascia is incised throughout the entire length of the wound 0.5 mm. behind (i.e., to the side of) the crest (*cr.a.*). This lays bare the bluish-red lachrymal sac (*sa.*). The lateral margin of the fascial wound (*fl.*) is grasped with the forceps, and the closed scissors made to separate the loose areolar tissue between sac (*sa.*) and fascia, as far back as the bone (*Meller*).

Marres', or Berger's operations (as shown in the diagrams), or by some modification of them.

The Relief of Occlusion of the Naso-lachrymal Duct

Not infrequently in cases of deformity of the nose, due either to trauma or disease, the naso-lachrymal duct is occluded, and it resists

all attempts to reestablish its patency. This occlusion is evidently due to destruction of the channel in the bone itself, the lachryma sac is always infected and, unless it is milked frequently, inflammation sets up and pus collects.

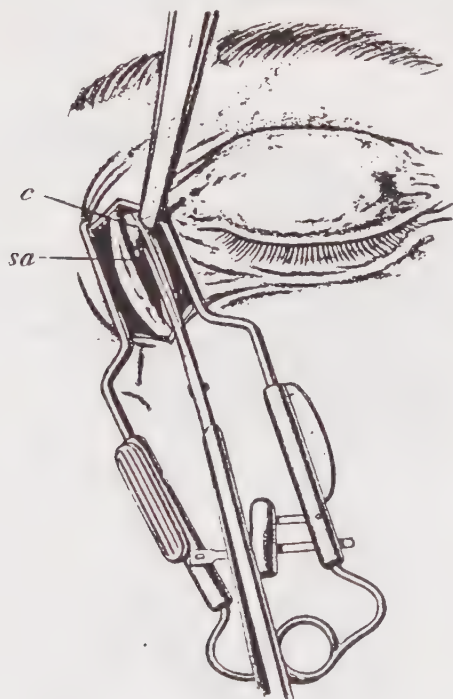


FIG. 377.—The lower half of the lateral wall of the sac is dissected from the deep fascia. The canaliculi (*c.*) are visible as a bluish cord above (*sa.*, sac).—To cut the canaliculi, one blade of the scissors, which must be applied parallel and close to the lateral fascia, is introduced far up behind the canaliculi (*c.*), the other is in front of them. One cut severs the canaliculi (*sa.*, sac) (*Meller*).

In these cases it may be advisable to refer the patient to an ophthalmic surgeon for the removal of the sac before other operative work is done. At times, however, conditions demand that this operation be done by the plastic surgeon. An excellent procedure for the removal of the lachrymal sac is that devised by Meller, which is fully explained in the diagrams.

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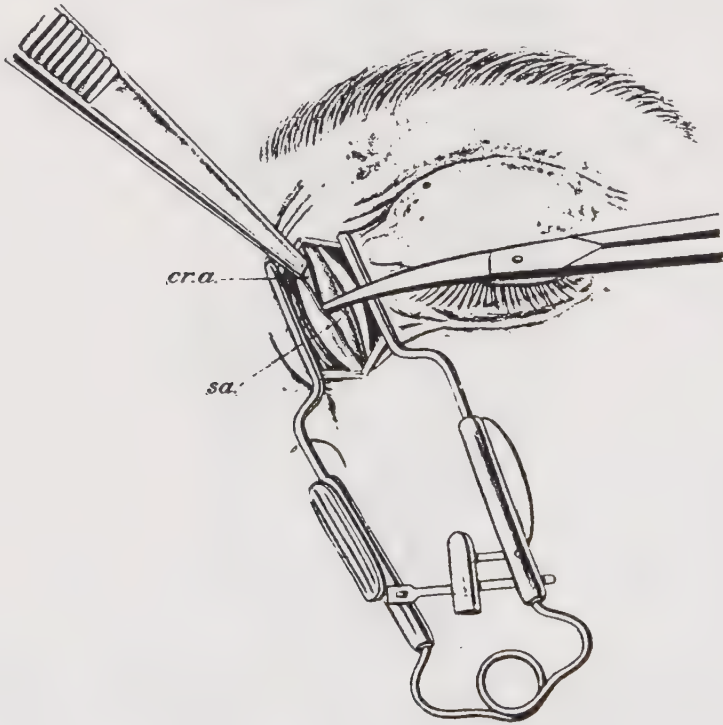


FIG. 378.—A short transverse cut (easily seen in Fig. 379 (i.), while in this drawing it is pulled to one side by the forceps) into the median margin of the fascial wound exposes the anterior crest (*cr.a.*); this makes it easy to push the closed scissors between the bone and *ac* (*sa.*) at the upper part of the crest and to loosen the sac. The point of the scissors is directed toward the bone (*Meller*).

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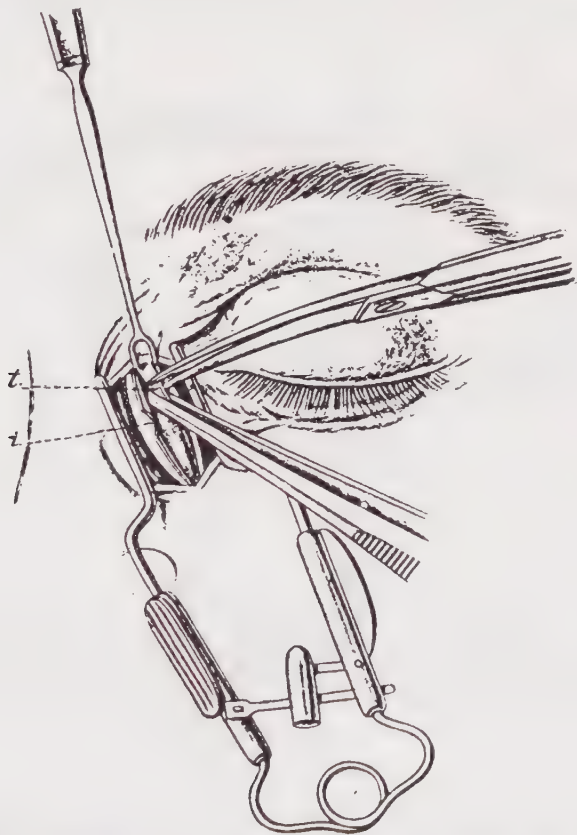


FIG. 379.—The sac having been freed on both sides, is now for the first time grasp with forceps near its apex (*t.*) and separated from the surrounding structures with sharp cuts of the scissors as near the sac wall as possible. The upper margin of the wound lifted up with a double tenaculum. *t.*, transverse cut into fascia (Meller).

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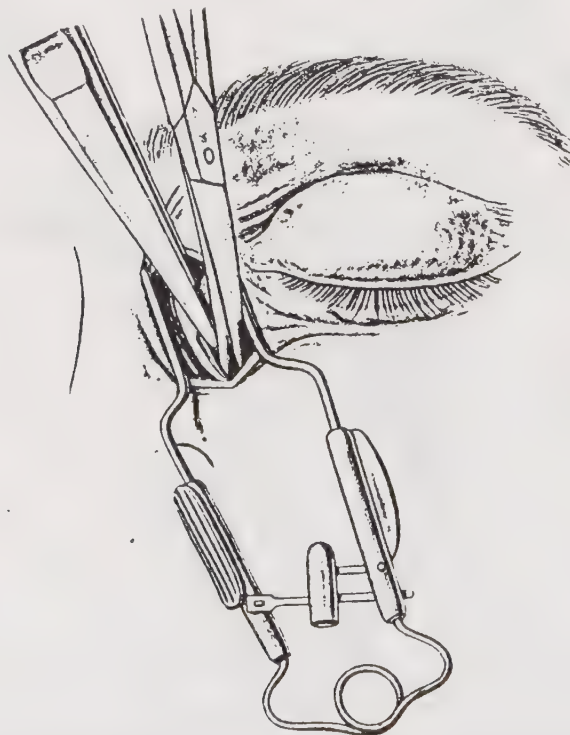


FIG. 380.—The sac, having been freed from the surrounding structures at all points except at its lowest portion, is grasped with the forceps low down; the vertically held scissors are made to cut away all the tissue attached to its lateral wall as close to it as possible until the naso-lachrymal duct is reached (Meller).

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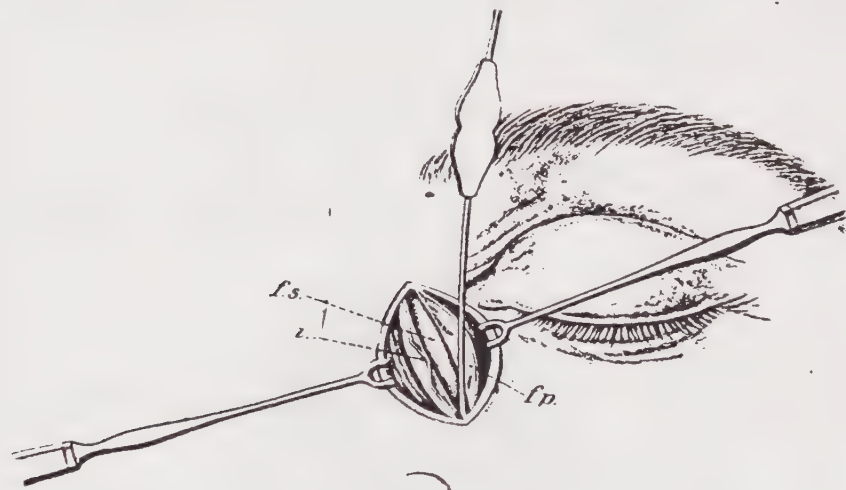


FIG. 381.—Operative field after complete excision. The small portion of the de-ascia, which has been left behind, is seen hanging to the anterior lachrymal crest, on it the transverse incision (*l.*) is still visible. The fossa (*f.s.*) is quite empty. The outer border is formed by the deep fascia (*f.p.*) which is firmly attached to the posterior lachrymal crest; it is of a white color and has a distinct luster. Behind the anterior crest is the pro which passes into the nose. In cases following trauma or lues this opening cannot generally be found—when it is found it should be thoroughly curetted before closing the soft part (*Meller*).

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CHAPTER XVIII

SURGERY OF THE EAR (OTOPLASTY)

Plastic surgery of the ear (pinna, auricle) deals with the correction and reconstruction of congenital or acquired malformations.

CONGENITAL MALFORMATIONS

In very rare cases the ear may be entirely lacking; more often it only partially defective. The auricle may be too large (macrotia)

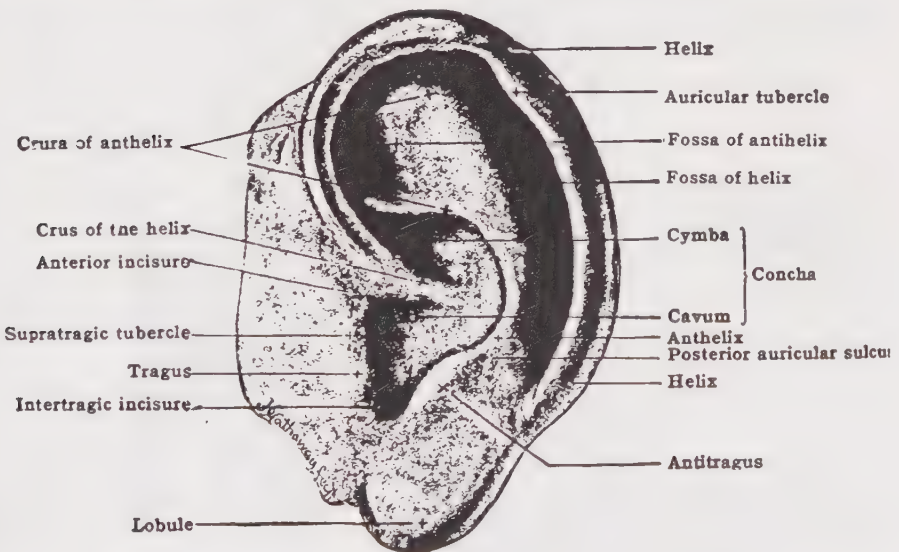


FIG. 382.—Lateral surface of a normal left auricle (*Morris*).

or too small (microtia); the contour may be abnormal; the ear may be smooth, the angle of the antihelix and the curl of the helix being missing. All of these conditions may be either unilateral or bilateral.

Abnormally small ears are usually accompanied by other malformations of the organ. Extensive defects of the auricle with normal formation of the other portions are rare. It is much more common to find the lobule absent, or poorly developed.

Auditory Meatus.—In extensive arrest of development of the ear here is usually atresia of the auditory meatus, and the skin over it may be dimpled or be perfectly smooth. The atresia may involve only the cartilaginous canal, or the canal through the bone may also be obliterated.

I have seen several of these cases. In some the x-ray plates showed a bony opening; in others there was the possibility of a bony opening being present. Taking into consideration the fact that a normal tym-



FIG. 383.—Arteries of the posterior surface of the ear (*Manchot*).—1. Posterior auricular artery. 2 and 3. Anterior branches of 1. 4. Temporal artery. 5. Anterior auricular artery.

tympanic membrane is seldom if ever found, I have not yet felt justified in trying to form a canal on the chance of finding a tympanic membrane. In cases of congenital atresia the mastoid process is apt to be imperfectly developed. Hearing is fairly acute in some of these individuals, and is probably transmitted through the bone.

Accessory Auricular Appendages.—These vary in size from a very small nodule to masses 1. to 2. cm. ($\frac{2}{3}$ to $\frac{4}{3}$ inch) in diameter. They are usually found on a line extending from the tragus to the angle of

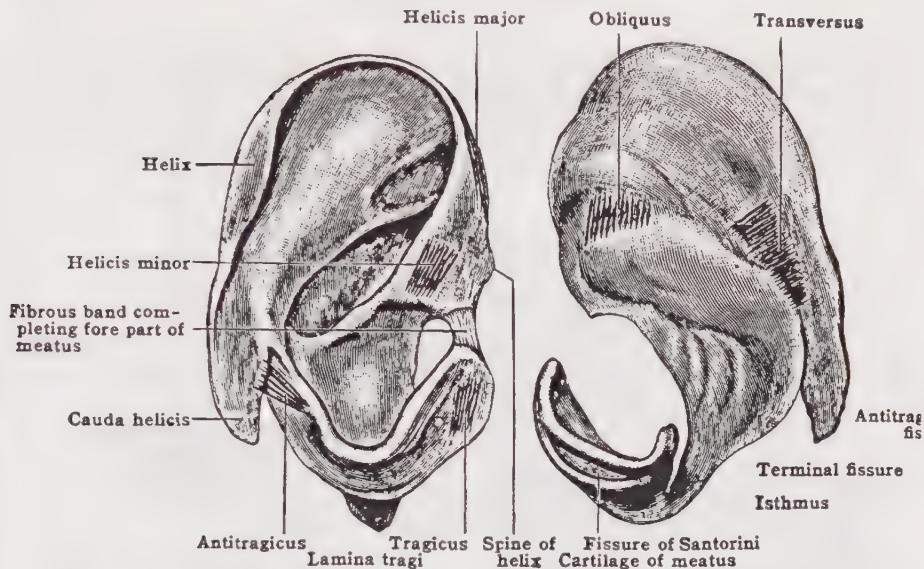


FIG. 384.—Lateral and medial surface of the cartilage of the right auricle and its mu (Morris).



FIG. 385.

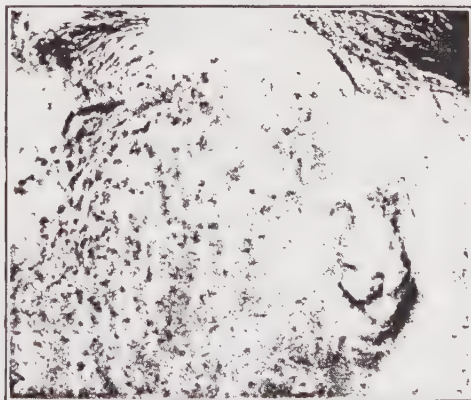


FIG. 386.

FIG. 385.—Congenital malformation of the ear.—This is not an unusual type of deformity. The best procedure is to infold the ear as far as possible by incisions brea the spring of the cartilage. The raw surface should be grafted and the ear held in corrected position until it is healed. In this way advantage may be taken of any su quent growth, and the final operation done when full growth is attained. In this case external auditory meatus was occluded, although the X-ray shows the presence of a men in the bone.

FIG. 386.—Congenital deformity of the ear associated with congenital absence o eye. The hearing is quite acute although the external auditory meatus is missing.

the mouth and corresponding to one of the transverse facial clefts. They consist of reticular cartilage, fat and skin, and occur as frequently with normal as with abnormal ears. I have seen them on the neck close to the clavicle. They may be removed without difficulty.

ACQUIRED DEFECTS

Acquired defects, due to injury or disease, may vary in extent, from total absence of the ear to any lesser degree of deformity. The treatment of congenital and acquired defects is practically the same.



FIG. 387.



FIG. 388.

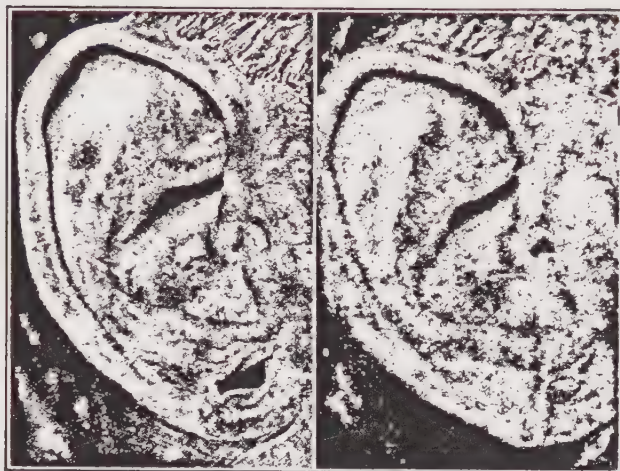
FIG. 387.—Accessory auricular appendage and malformation of the nose.—Note the typical accessory auricular appendage in front of the ear. A tumor can also be seen on the nose. This is composed of cartilage and skin and has a few long hairs growing on it.

FIG. 388.—Deformity of the ear with a large accessory auricular appendage.

Operations for the reconstruction of the ear should not be undertaken until the patient is well grown. In those instances in which the auricle is small and curled on itself, I usually attempt within the first few months of life to uncurl the auricle, and place it in a position which will prevent, as far as possible, greater deformity as the organ develops.

Several years may elapse before the work can be completed, as time must be allowed for shrinkage and readjustment between operations. In all reconstructive or corrective operations on the ear, care must be taken to make the two ears as symmetrical as possible. Skin and cartilage should be conserved for use in secondary operations. When removing the cartilage from the auricle the skin on the opposite surface of the ear must not be buttonholed.

Preparation.—Either soap and water, or the iodine technic may be used in preparation of the part. If iodine is used the excess should be



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FIG. 389.—Partial destruction of the center of the lobule due to trauma.—The defect was filled by the use of a pedunculated flap from the slack skin on the back of the lobule with its pedicle at the margin of the defect. The rest of the margin was freshened and the flap was sutured into place. The raw surface on the back of the lobule was undercut and sutured over the flap. The appearance could have been much improved, but the patient was so well satisfied that nothing further was done.



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FIG. 390.—Deformity of the ear following an extensive burn.—1. The cartilage of the upper portion of the helix had been destroyed and that part of the ear was covered with thin adherent scar tissue. 2. The cartilaginous stumps were dissected out and the skin was broken by the necessary excisions. The edges of the cartilage were then sutured in position, and the scar tissue closed over the cartilage.

ashed off with alcohol. A plug of sterile cotton should always be placed in the meatus before cleansing or operating.

Anesthesia.—Many operations on the ear itself can be done under a local anesthetic, by blocking off the ear, or by infiltration. If an extensive operation is contemplated, with lifting of flaps and other manipulations, a general anesthetic is desirable.

Horsehair is the best suture material for the skin, and fine catgut for the buried sutures. Aseptic healing is essential, as sometimes perichondritis and infection of the cartilage occurs, which is always difficult to control.

As far as possible incisions should be on the posterior surface of the ear.

The natural spring of the ear cartilage should be broken by incision or excision of a portion in all corrective operations; otherwise there will be stretching of the scar and a partial recurrence, at least, will follow.

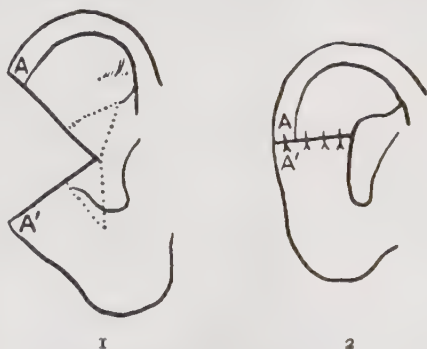


FIG. 391.—The repair of loss of substance of the auricle (*Cocheril*).—The dotted lines indicate the triangles to be removed to make possible the approximation of the ends of the helix *A* and *A'*. The size of the triangle varies with the situation and shape of the defect to be closed.



FIG. 392.—Boxer's ear (hematoma). Duration several years.—In a case of this kind careful dissection, excision and reshaping of the thickened and deformed cartilages is necessary.

INJURIES OF THE EAR

Recent injuries of the ears are seldom referred to the plastic surgeon. Lacerated wounds, however extensive, should be carefully sutured, as cases have been reported in which the whole or a part of the ear have been entirely severed, and after suture have healed in place. Frequently only a small tag of skin may be left connecting the ear with the scalp. In all wounds of the ear care must be taken that the external auditory meatus is kept open. Absolutely accurate suturing is essential, skin must be sutured to skin and cartilage to cartilage.

HEMATOMA AURIS (OTHEMATOMA).—Occasionally an early case of hematoma of the ear is seen before organization has taken place. This is always due to trauma and usually is associated with a fracture of the cartilage. The blood collects beneath the unbroken perichondrium, which together

with the skin is raised and forms a swelling of varying size on the outer surface of the ear. The best treatment I have seen for this condition is that devised by D. H. Palmer. If organization has not taken place a small incision is made into the cavity in the most dependent portion of the swelling. The contents are removed with a curette and the surface of the cartilage and perichondrium is scraped until smooth. The incision is closed except for an opening just large enough to admit the end of an eustachian catheter connected through a waste bottle with a continuous suction apparatus. In this way any blood can be removed, and the perichondrium and cartilage are brought together. The ear and adjacent tissues are anointed with sterile vaselin and surrounded by a paste-board mold, into which is poured a thick cream of plaster-of-Paris. This surrounds the ear, front and back, and holds the parts in absolute approximation. The suction is continued during this process and the catheter is rotated as the plaster hardens, so that it can be easily removed, leaving an opening for drainage. The cast is supported with a bandage and is removed by fragmentation after ten days. The results are usually excellent.

CAULIFLOWER EAR (BOXERS', FOOTBALL EAR) is a condition which follows the complete organization of a hematoma auris, with a resulting deformity of the ear which may be considerable. The area occupied by the original hematoma is filled with cartilage, scar tissue, and, in some cases, even with new bone. There is thickening and distortion of the contour of the ear and obliteration of the fossæ (Fig. 392).

The treatment consists in removal of the thickened tissue, and in very pronounced cases areas of skin and cartilage.

The size of the damaged organ should be made to correspond as closely as possible with that of the normal ear; the skin edges are closed and a small horsehair drain is inserted. An even pressure can be maintained by filling all the irregularities on both back and front of the ear with wet cotton over a layer of gauze which, as it dries, makes quite a good mold. A plaster-of-Paris cast, or a paraffin mold can also be used.

Malformation of the Lobule

Attachments (Synechia) of the Lobule.—The inner border of the lobule may be attached to the skin of the neck, either congenitally following burns, and often requires operation such as those devised by Binnie and by Kolle, either for cosmetic reasons, or (in scars) for relief of tension (Figs. 393 and 394).

Quite a common deformity of the lobule is due to the gradual or forcible tearing out of ear-rings.

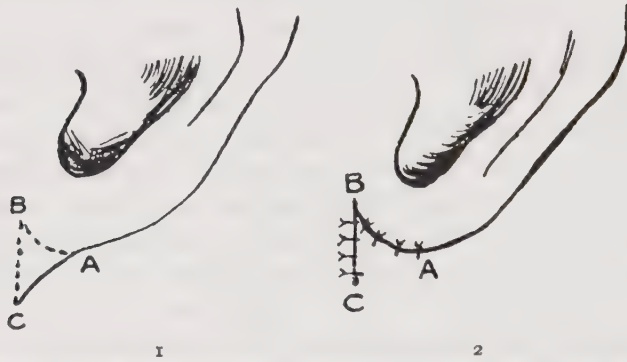


FIG. 393.—Operation for synchia (*Kolle*).—1 and 2. A curved incision *AB* is made, outlining the proposed margin of the lobule. From the inner extremity of this line a vertical incision *BC* is made which terminates on the skin surface. The triangle of tissue thus outlined is removed and the edges are sutured.

A simple operation for correcting a defect in the lobule is to excise the cicatricial edges of the defect through the full thickness of the lobule and approximate the freshened surfaces. The disadvantage of

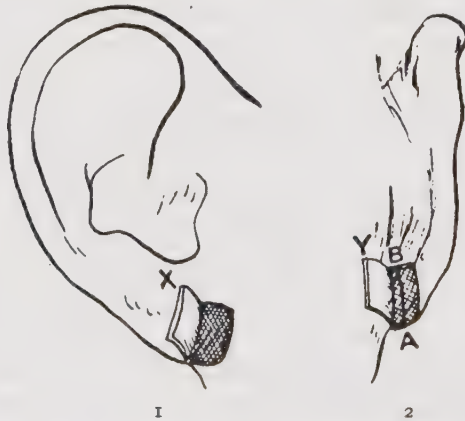


FIG. 394.—Operation for the correction of attachment of the lobule (*Binnie*).—Determine the line along which the lobule should be separated. In front of the ear raise the flap *X*, having its base on the ear corresponding to the above-mentioned line. On the back of the ear raise the flap *Y*, having its base on the neck. Separate the lobule along the line *AB*. With the flap *X* cover the defect on the inner side of the lobule. Suture the flap *Y* into the defect on the neck.

The method is that usually a notch is left. This can be overcome by either making the incisions slightly curved, or by removing a small edge of tissue from each side, thus lengthening the suture line and over-

correcting, very much as when operating for harelip (Figs. 397 and 398).

Green's operation is rather complicated, as can be seen from the diagrams; it was designed to overcome the notching which follows the



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FIG. 395.—Adhesion of the lobule to the cheek following a burn.—1. The lobule is closely bound to the cheek by a thick scar, and there is sufficient traction to cause discomfort. Result of operation releasing and reforming the margin of the lobule.

modified simple operation. The weak point is the thin tip of scar tissue which is liable to slough (Fig. 399).

Enlarged Lobule.—The lobule of the ear is sometimes considerably enlarged, either in connection with macrotia; or it may be enlarged



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FIG. 396.—Adhesion of the lobule to the cheek following a burn.—1. The synechia, in this case differs from that in Fig. 395 as the lobule is stretched considerably more, and is adherent for a greater distance. The sensation of tension and drawing is much more marked. 2. Result of operation. Note the difference in the shape of the lobule in the two cases.

without any increase in size of the rest of the auricle. This malformation may be corrected by the removal of a wedge of tissue through the full thickness of the ear, as will be described in Joseph's operation for

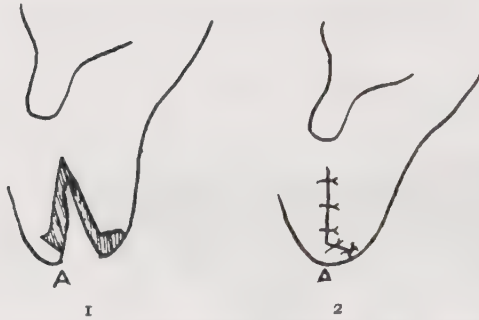


FIG. 397.—Operation for loss of substance in the lobule (*Mirault*).—1. The shaded area shows the scar excised. Note the tip A on one side of the defect, and the denuded area on the other. 2. The tip A is sutured over this, thereby avoiding a notch.

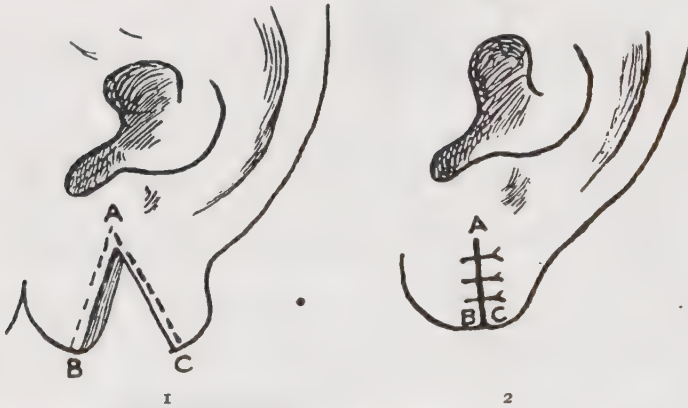


FIG. 398.—Operation for correction of lobular defect.—1. The dotted lines indicate the incisions for the removal of the cicatricial margins of the defect BAC. 2. The points B and C are approximated and the wound is closed.

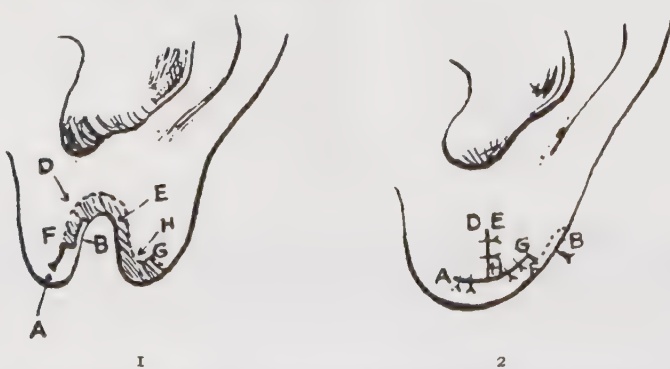


FIG. 399.—Green's operation for correcting a lobular defect (*Kolle*).—1. The dotted line D shows the incision for removing the cicatricial skin. The line AF marks out the flap with a thin marginal tip B, which is to be used to obliterate the notch. 2. The scar is excised and the edges are approximated. Then H is sutured to A, F to G. The thin tip B being sutured to a denuded surface along the margin.

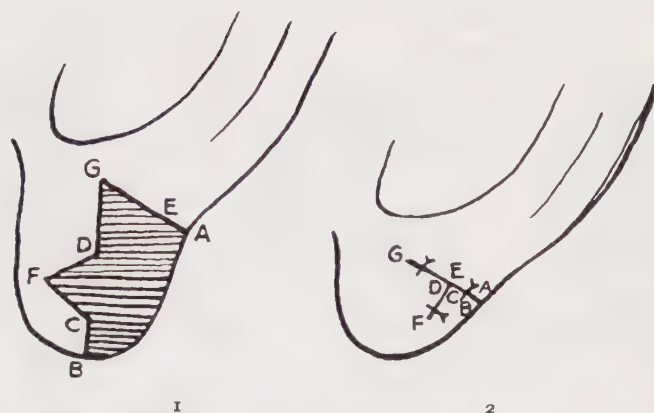


FIG. 400.—Operation for correcting an abnormally long lobule (*J. Joseph*).—1. An area including the full thickness of the lobule, shaped as indicated in the diagram, is excised. 2. The edges DF and FC are sutured. Then DG to EG, and CB to EA.

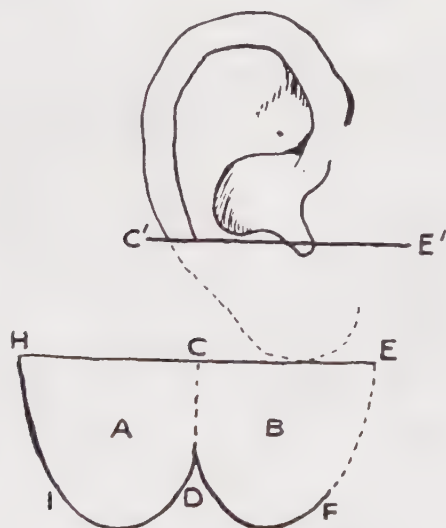


FIG. 401.—Gavello's operation for the reconstruction of the lobule (*Laurens*).—The auricle is pulled upward. In the skin immediately below the stump a flap one-third larger than the lobule to be made as outlined, having its base EF on the cheek. The upper incision HE is straight and is parallel to the border of the defect C'E'. The lower incision is a double half-curve IDF, forming two scallops AB, as is shown in the diagram. The flap is raised and folded on itself, raw surface A behind to raw surface B, and the posterior and lower borders are sutured. Then the upper border CE is sutured to the denuded edge of the auricle, on the line C'E'. The defect from which the flap is raised can usually be closed after undercutting the surrounding skin.

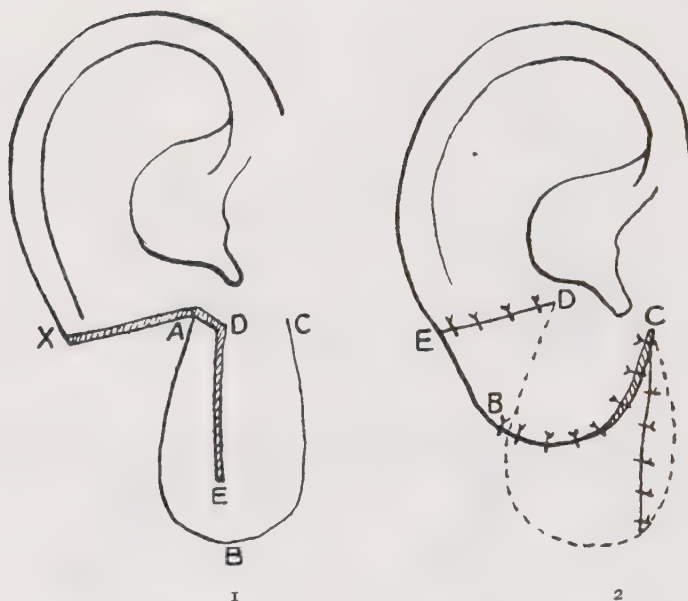


FIG. 402.—Nélaton's method of restoring the lobule (*Cocheril*).—1. The shaded area KDE indicates the raw surface. The dark line ABC indicates the outline of the flap. The flap is raised and folded on itself at EB. The point E being sutured to X. The dotted lines indicate the area of undercutting necessary in order to close the gap left by raising the flap.

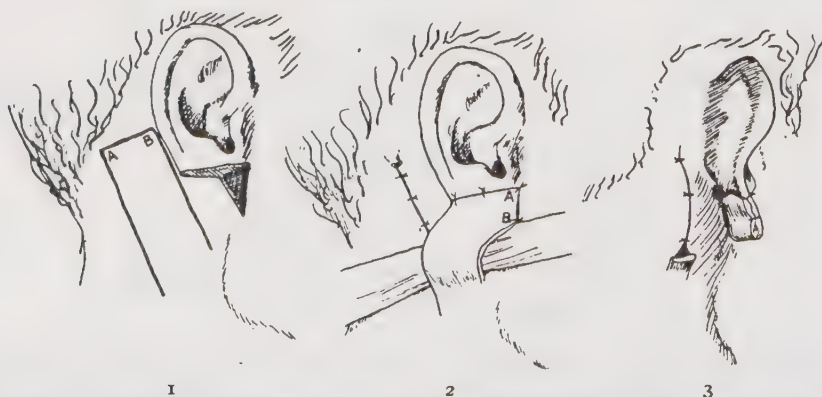


FIG. 403.—Operation for the restoration of the lobule (*modified from Nélaton and Ombré-annne*).—1, 2 and 3. A flap considerably wider than the defect to be filled is raised from the skin behind the ear, with its pedicle on the skin of the neck, on a line with the auditory canal. The flap is raised and the free edge AB is sutured to the freshened defect on the neck. A roll of iodoform gauze is placed under the flap. The wound on the neck is sutured. Ten days after the pedicle is severed and the flap is folded on itself, raw surface to raw surface, and the edges sutured. Subsequently a trimming operation is necessary to smooth the contour. This is an excellent operation and I have used it with satisfaction.

macrotia; or by an operation also devised by Joseph which eliminates the notching of the tip of the lobule (Fig. 400).

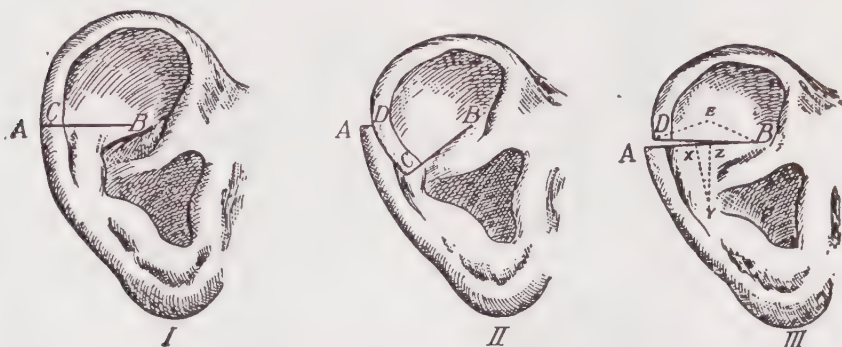


FIG. 404.—Operation for macrotia (*Binnie*).—1. Make the incision *AB* through the ear and pull down the upper flap the desired distance. 2. The triangle of tissue *DCB* is removed. 3. In order to make the line *DB* and *AB* of equal length, excise the triangle *DEB* and *XYZ*. Then approximate the edges with sutures.

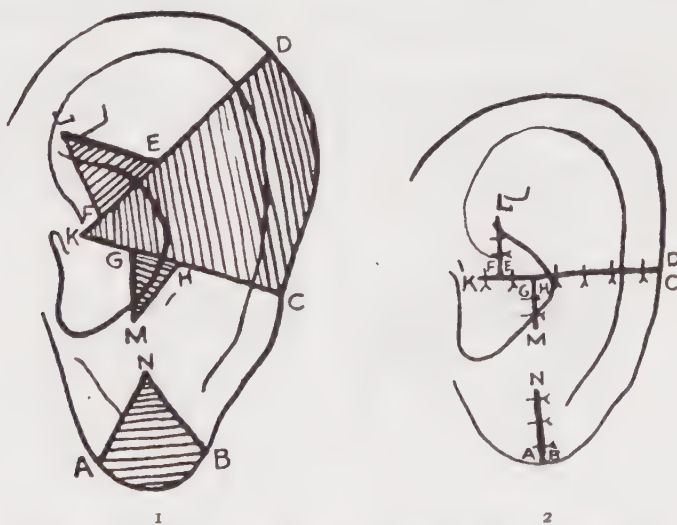


FIG. 405.—Operation for macrotia (*Martino, Trendelenburg, and J. Joseph*).—1. A wedge of tissue including the full thickness of the auricle of the necessary size, *DKC* removed. This reduces the length of the ear. In order to make the edge *DK* correspond in length with the edge *CK*, and at the same time to reduce the width of the ear, the angles *EFL* and *GMH* are removed. If the lobule is also enlarged this is reduced by excision of the triangle of tissue *ANB*. 2. The edges *FL* to *EL*, and *GM* to *HM*, are sutured, then the edges *DK* to *CK*, and finally *AN* to *BN*. This is an excellent operation inasmuch as it reduces the size of the ear in all its dimensions.

Restoration of the Lobule.—Absence of the lobule may be due to congenital maldevelopment; it may also be found as the result of an operation for the removal of a malignant growth, of ulceration or



FIG. 406.

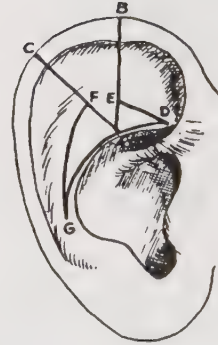


FIG. 407.

FIG. 406.—Operation for macrotia (*Cocheril*).—The shaded areas indicate the portions excised from the full thickness of the ear. When sutured, C is brought to C', A to A', B to B', and D to D'.

FIG. 407.—Operation for macrotia (*Cheyne and Burghard*).—A V-shaped piece of the full thickness of the ear CAB is excised from the upper and outer part of the auricle. The base of the wedge is at the outer margin of the helix, and the apex through the antihelix. Corresponding to the margin of the antihelix a curved incision GAD, is made through the full thickness of the ear, and from the extremities of this incision two short curved incisions DE and GF are made, which end in the triangular defect. The tissue included by these incisions is removed. B is sutured to C, F and E to A.

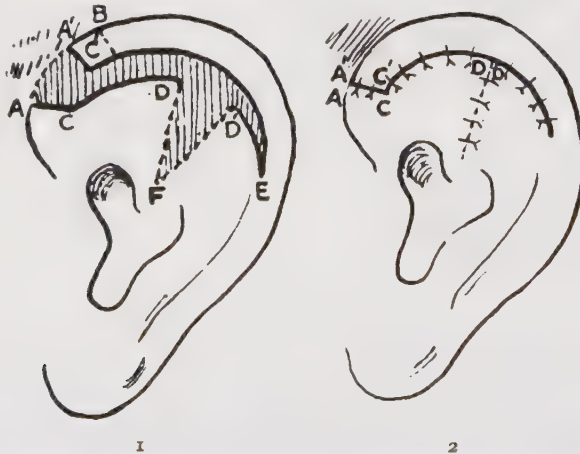


FIG. 408.—Operation for macrotia to avoid a disfiguring notch (*Kolle*).—1. A sickle-shaped area of tissue AEA' through the thickness of the ear is removed. Its handle CA'C' is on the level with the upper border of the zygomatic process. The upper curvature of the incision follows the inferior border of the helix and extends well into the fossa of the helix. If the antihelix is large a triangular area DFD' is excised. The dotted line indicates the area of helix which may be removed if shortening is necessary. 2. The edges are closed and the ear reduced in size.

trauma. It is of great importance to the patient as far as personal appearance is concerned.

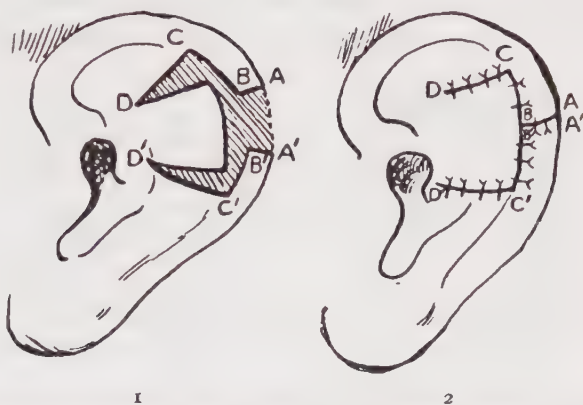


FIG. 409.—Operation for macrotia (*Kolle*).—1. An area of tissue ACDD'C'A', including the entire thickness of the ear is excised from the upper outer portion of the helix and fossa of the helix. This gives the outline of a short wide two-pronged fork. The incisions making the prongs are slightly curved, so that when the edges are sutured they will be a slight convexity. 2. Shows the edges approximated.

Several excellent operations have been devised by Gavello, Nélator, Ombrédanne, and others, for the reconstruction of the lobule. I have

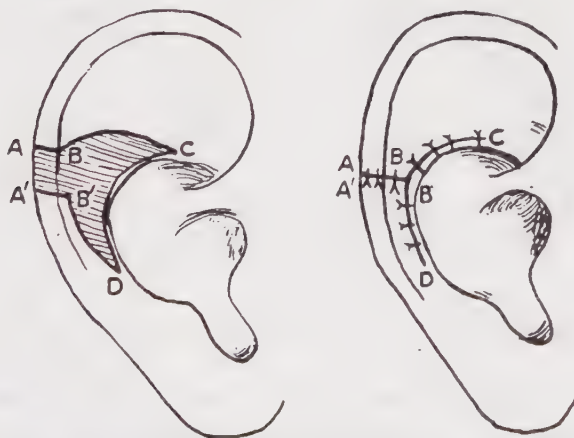


FIG. 410.—Parkhill's operation for macrotia (*Roberts*).—1. A crescentic piece of the full thickness of the ear is removed from the center of the pinna with a tongue-like process extending from the convex border of the crescent to and including the helix. The distance AB and A'B' should be equal. The edges AB and A'B' are sutured and then the crescentic defect.

used those of which diagrams are shown, with success. The shape and position of the flaps must be modified to meet conditions (Figs. 401-403).

Macrotia (ABNORMALLY LARGE EAR)

The auricle is uniformly enlarged, and the ear is unsightly. Several operations have been devised by Schwartz, Cheyne and Burghard,

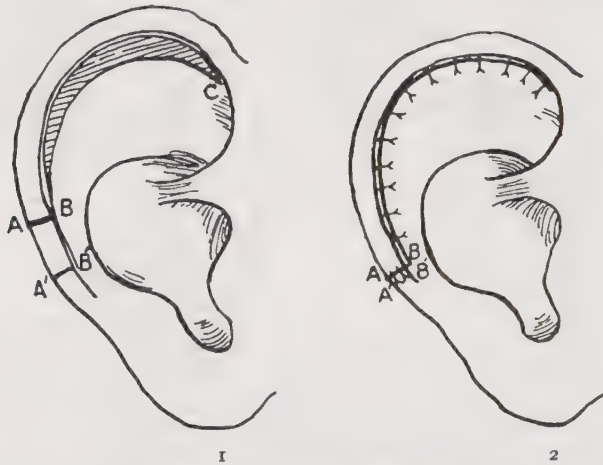


FIG. 411.—Gersuny's operation for closing a defect in the helix (*J. S. Stone*).—When the defect on the helix is low down a crescentic piece of tissue should be removed from the most prominent and curving portion of the ear, and not in the area adjacent to the defect. The edges are sutured.

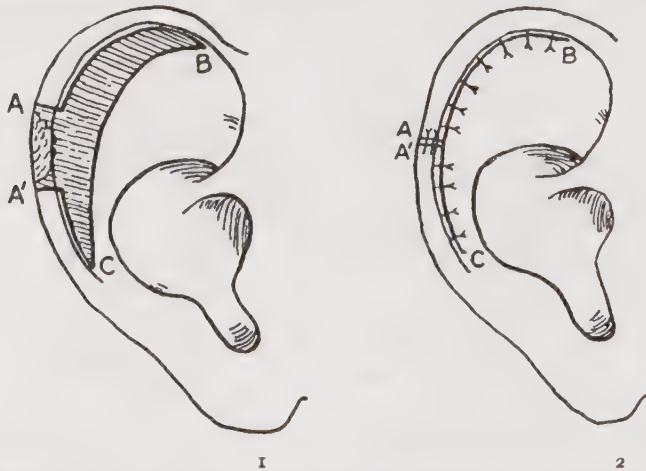


FIG. 412.—Operation for closing a defect in the helix or reducing the size of the ear (*Gersuny*).—A crescentic-shaped piece of the ear BC is removed from the outer part of the fossa and just inside the margin of the helix. The outer upper border of the excised crescent should extend to the point where the helix is attached to the head. The width of the crescent should be about two-thirds of the width of the gap in the helix, AA', which is closed. The ends of the helix should be sutured first, and then the crescentic incision.

Parkhill, Kolle, Gersuny, Joseph, and others, for the correction of this deformity. Good results may be obtained.

The objection to Kolle's second method, and to both of Gersuny's operations, is that the blood supply of the flap of helix is endangered on account of its length and narrow pedicle (Fig. 404-413).

Microtia (ABSENCE OF THE EAR), CONGENITAL OR ACQUIRED

When the entire ear or a large part of it is missing, the possibility of successful plastic reconstruction is doubtful, and at best the cosmetic results are only fair. Nevertheless, some of my patients have preferred to undergo the necessary discomforts in order to have an ear made of their own tissues.

Many years ago Szymanowski proposed a procedure which has been tried from time to time, and as far as the incision goes, it seems to be

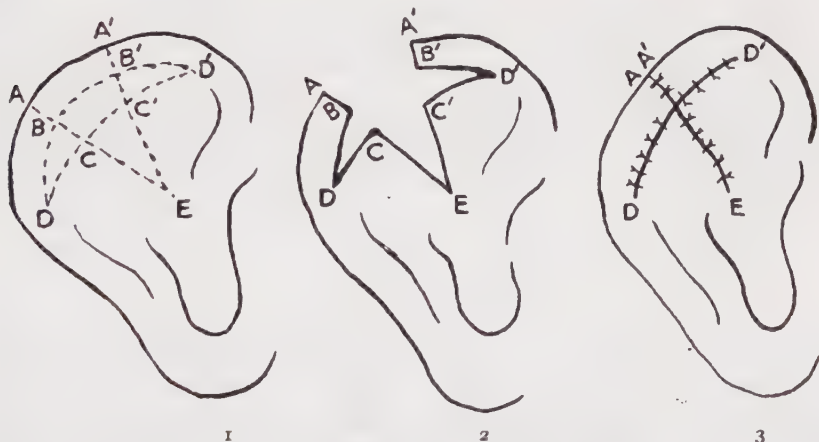


FIG. 413.—Schwartz's operation for microtia (Kolle).—1 and 2. A long crescent-shaped piece of tissue DBD'C is removed from the full thickness of the auricle in the fossa of the helix. A triangle of tissue AEA' is then excised, its base corresponding to the outer border of the helix, and its apex well within the concha. 3. The edges are closed as indicated.

the best method of raising a flap from adjacent tissue for the purpose of forming an auricle.

Szymanowski's Operation for Reconstructing the Auricle.—An incision is made on the scalp, as shown in the diagrams, back of the rudimentary ear or external auditory meatus. This flap should be planned at least one-third larger than the auricle which it is proposed to make and should consist of skin and subcutaneous tissue. The flap is dissected up, and is folded on itself at the constricted portion so that raw surface is in apposition to raw surface. The margins are sutured above and below. Close the defect left by lifting the flap with

sutures, as far as possible, and graft the uncovered portion. Support the double faced flap with gauze pads. Later, by several plastic operations the auricle is shaped, pushed forward, and the lobule formed (Fig. 414).

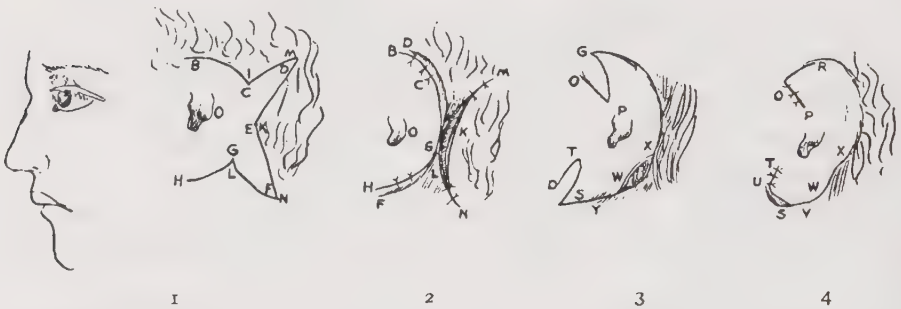


FIG. 414.—Operation for reconstruction of an ear (*Szymanowski*).—1. Make the incision BIMKNLH, and dissect up the flap as far as the canal or rudimentary ear in the center, and to the line BH connecting the flap above and below the canal. 2. Fold the whole flap on itself on the line IL, bringing raw surface to raw surface. The tip D is then brought to the point B, and the tip F to the point H. The point E to the point O. 3. After healing is complete raise the flaps OPG, and STD, and place them behind the auricle and approximate the edges. 4. The lobule is formed by subsequent trimming operations.

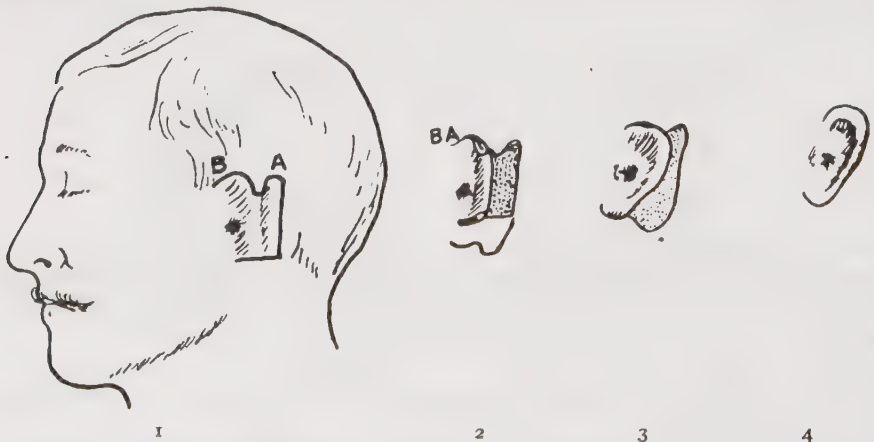


FIG. 415.—Roberts' operation for reconstruction of the auricle (*J. C. Beck*).—1. Outline of the flap to be raised. 2. The flap folded on itself. Outline of the lower flap to be folded on itself after healing is complete in the upper flap. 3 and 4. Process completed. The drawing idealizes the result.

The operation as it was originally proposed is of little practical use, but its cosmetic value can be enhanced by utilizing shaped rib cartilage for a supporting framework.

I have done this on several occasions with a fair degree of success, but have as yet not completed the ear on any single case, as these

patients are still returning from time to time for further operative work. Although it might seem a simple procedure it is quite difficult to keep the main portion of the flap, which is to form the auricle, from adhering to the head, except at the margin. I have tried to overcome this by grafting the raw surfaces, but without complete success.

The best method is by swinging up a pedunculated flap from the neck and suturing it to the posterior portion of the auricle, after dissecting it well away from the head. Ten days later the pedicle is cut

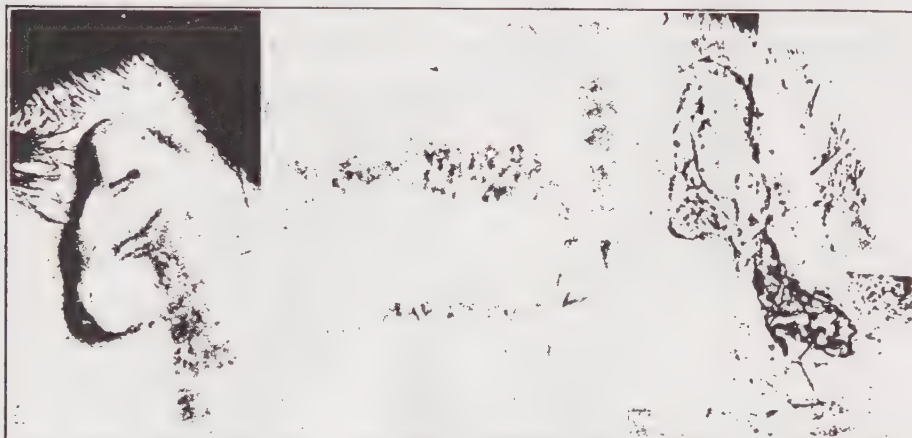


FIG. 416.—Congenital malformation of the ear.—1. The rudimentary ear. There is definite atrophy of the face on the left side. 2. The normal ear is very prominent. Note the deficiency in the mastoid region as compared with the right side. 3. The body of the prospective ear has been formed from a flap raised from behind the rudimentary ear and it has been braced with pieces of cartilaginous rib. There is much difficulty in keeping this portion from close adherence to the head. To overcome this a flap has been turned up from the neck, and sutured in such a way as to line it. The flap in place. Note the tooth picks inserted between the flap and the head to show the depth of the lining.

I have transplanted a cartilaginous rib for a framework at the time of raising the flap, including it between the raw surfaces where the flap was folded. At other times I have waited until the surfaces had grown together and then inserted the cartilage in channels burrowed between the flaps. It is difficult to secure these grafts so that they will stay in the desired position (Figs. 416 and 417).

Another difficulty in using the scalp flap is the presence of hair on the ear, but this can be subsequently removed with radium or with x-ray. I always attempt to utilize the rudimentary ear and have found it useful in forming a lobule.

A new ear may be reconstructed by means of pedunculated flap from the arm or chest wall, or by double transfer from abdomen to arm

o ear. It is advantageous to implant properly shaped pieces of cartilage into these flaps for the purpose of support and to allow the raft to heal in place before suturing the flap to the head.

Artificial Ears

In the majority of cases in which total reconstruction of the ear is necessary, we are justified in advising the use of a prosthetic apparatus.

Artificial ears can be constructed quite perfectly, and to match the normal ear exactly. They are made of celluloid, wax, papier maché

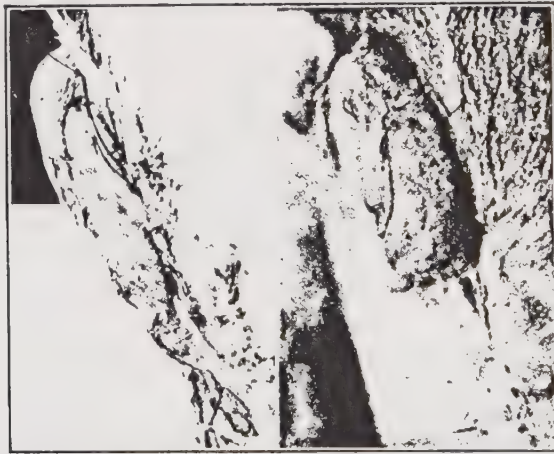


FIG. 417.—Congenital malformation of the ear continued.—1. A posterior view of 3 in g. 416. 2. Three weeks later, after severing the pedicle. The rudimentary ear will eventually be used to form the lobule. The process of forming the ear in this case is not arly completed, but it might be said that a good start has been made. A number of rther operations will be necessary.

and rubber. Recently a flexible ear has been made of a rubber mixture which is colored to match the skin. They are held in place by adhesive paste and various devices, depending on the size and situation of the bump.

Losses of Substance in the Auricle

Losses of substance in the auricle are of two kinds: those involving the margin, or the margin and body, of the auricle, and those in which the margin is intact, but the center is perforated. These defects may vary in size (Fig. 418).

Dieffenbach's operation.—A horizontal flap of sufficient size is marked out on the skin of the mastoid region, with its base posterior,

and the free extremity behind the ear is raised and sutured into the defect. After ten days the pedicle is severed and the body of the flap is folded behind the anterior portion already in place, and raw surface is sutured to raw surface. The defect from which the flap is raised is either closed with sutures, or is grafted (Fig. 419).

The hair can be subsequently removed with radium or with *x-ray*. If the gap filled by this flap is wide, and the margin of the ear tends to sag, a shaped piece of cartilaginous rib may be inserted between the skin layers.

Nélaton and Ombrédanne's Operation for Loss of Substance in the Lower Portion of the Auricle.—A flap of sufficient length and width is raised from the occipito-mastoid region with its base anterior (behind



FIG. 418.

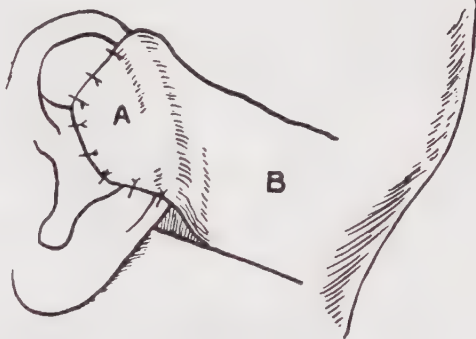


FIG. 419.

FIG. 418.—Perforation of central portion of the auricle (*Cocheril*).

FIG. 419.—Operation for loss of auricular substance (*Dieffenbach*).—The pedunculated flap A with its pedicle B in the mastoid region, and its free end behind the ear is raised and is sutured into the defect. Ten days later the pedicle is cut and the pedicle end of the flap is folded so that it covers the raw surface of flap A.

the ear). It is folded on itself (making the margin of the ear) raw surface to raw surface, and its edges are sutured into the loss of substance. The defect made by raising the flap is either sutured or grafted. After ten days the pedicle is divided and sutured to the inner border of the defect. This flap can also be stiffened with a cartilaginous graft if necessary (Fig. 420).

The cartilage of the ear may be either partly, or completely, destroyed by third degree burns and the remaining portion be covered with scar tissue, or be adherent to the mastoid region. Sometimes it is a difficult matter to separate the ear from the head and prevent recurrence of the deformity.

J. C. Beck's Operation for Adherence (Synechia) of the Auricle to the Mastoid Region.—(This procedure can also be utilized for repairing losses of substance.) Separate the adherent ear from the mastoid surface, and pack the space with gauze until granulations have formed. At the same time raise a pedunculated flap, shaped to cover the posterior surface of the auricle and the mastoid defect, from the front of the forearm. Either arm may be used for this purpose. Separate the flap from its base with rubber tissue to prevent adherence and to allow thickening. One week later freshen the raw surfaces, raise the forearm, and suture the flap from the arm to the posterior surface of the auricle and on the mastoid defect. Secure with a plaster cast.

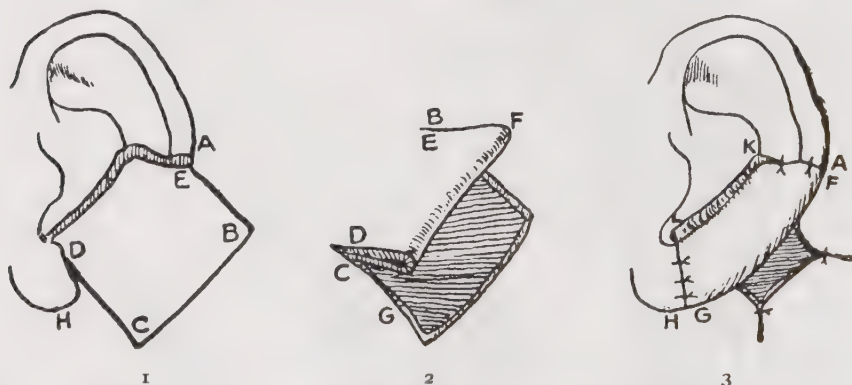


FIG. 420.—Operation for loss of substance of the auricle (*modified from Nélaton and Ombré-ville*).—1. Shows the defect and the outline of the flap with its base behind the ear on the line DE. 2. The flap folded on itself raw surface to raw surface. 3. The flap sutured into the defect. After ten days the pedicle is cut and sutured into the line LK.

Ten days later amputate the flap from the arm and fit it into the uncovered portion of the defect. Care should be taken to make a natural fold at the root of the auricle. The defect on the forearm may be closed with sutures, or at least lessened in size; the remaining defect could be grafted.

The adhesion between the auricle and the mastoid region can be relieved by a pedunculated flap turned up from the neck. This is an excellent method. I have used whole-thickness grafts and Ollier-Hirsch grafts with fair success, but the pedunculated flaps give the best results.

Perforations of the Auricle

Small perforations of the auricle can be closed by properly shaped flaps of skin from the ear itself. If the perforation is of considerable

size, it should be closed by means of a pedunculated flap from the scalp or neck, turned on itself, as previously described in other operations. The Italian method may also be used in selected cases.



FIG. 421.—Partial reconstruction of the ear for a defect following trauma.—Duration several months. 1. The extent of the defect is well shown. Note that the remaining portion of the ear stands well away from the head. 2, 3 and 4. The reconstructed portion three months later. Several shaping operations will be necessary to complete the work. The flap to reconstruct the ear was obtained from the hairless portion of the skin behind and below the ear. The uninjured ear was also very prominent and the cartilage removed from this ear was utilized in preparing the framework, and the skin also was employed for filling defects.

Retro-auricular Fistulæ and Depressions

Some of these fistulæ are the result of radical mastoid operation with long-continued drainage. They are lined with epithelium and are

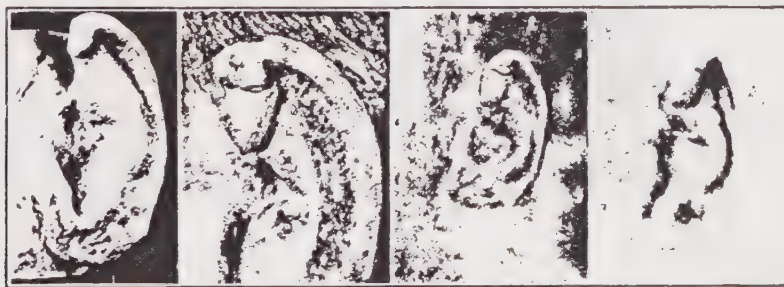


FIG. 422.—Reconstruction of the anterior portion of the helix.—1. Plaster cast showing the defect. 2. Six weeks after shifting up a flap from the hairless portion of the scalp immediately behind the ear, with pedicle above, and turning it on itself to fill out the defect. The pedicle has been cut and the wound from which the flap was taken closed. 3. Three months later, after shaping operations. 4. Two and a half years after transplantation of the flap. The ear would scarcely be noticed as defective from a distance of a few feet.

continuous with the skin; they may open into the external auditory canal, but sometimes there is no such connection, the defect being

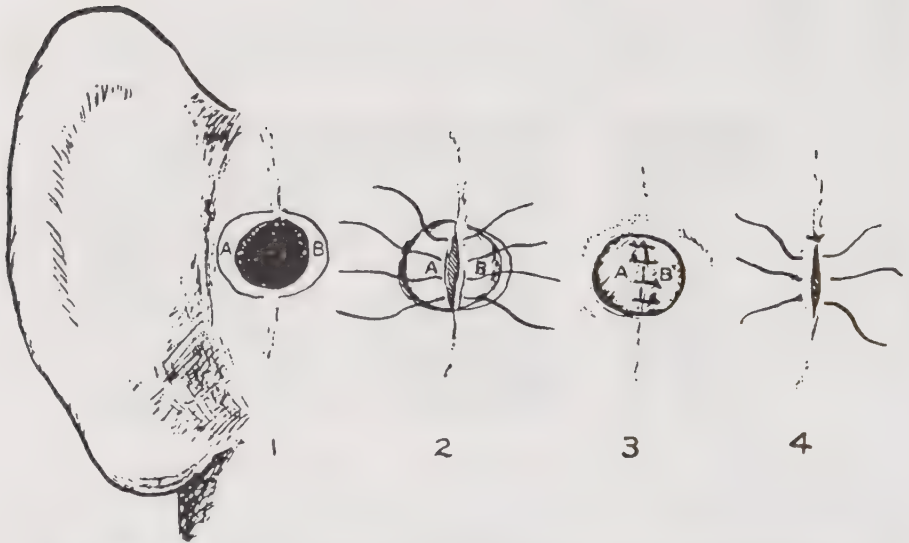


FIG. 423.—Trautmann's operation for retroauricular fistula (Goldstein).—1 and 2. Raise two crescentic flaps A and B from the edges of the fistula, turn them in and suture the edges together, closing the opening. 3 and 4. Then undercut the skin all around the fistula, and draw the edges together with sutures over the sutured flaps. Lateral relaxation incisions may be necessary.

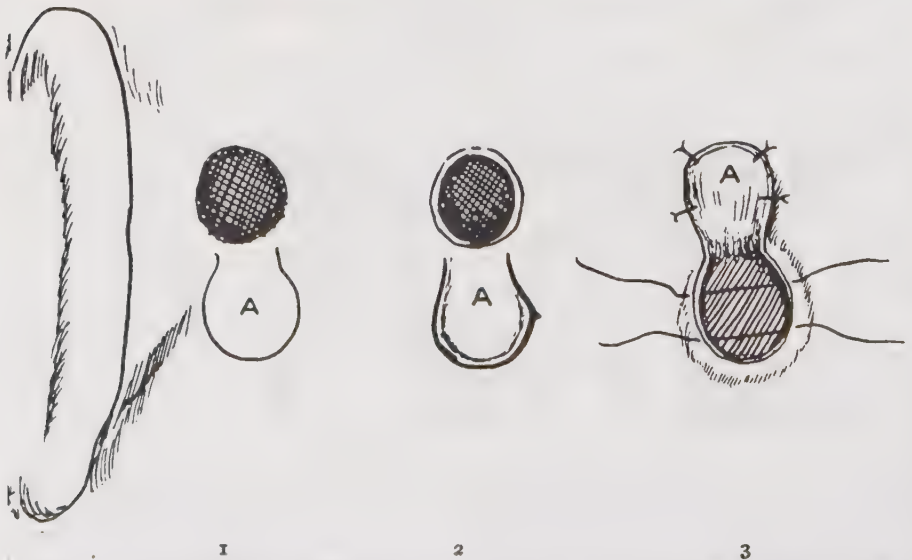


FIG. 424.—v. Mosetig-Moorhoff's operation for the closure of a retroauricular fistula (Goldstein).—Raise a tongue-shaped pedunculated flap from the skin above or below the fistula with its pedicle close to the fistula. Freshen and loosen the edges of the fistula except that adjacent to the pedicle. Turn the flap over, epithelial surface downward, and ture it into the margin of the fistula. The defect, from which the flap is raised, is sutured and grafted, and the raw surface of the flap is grafted. Ten days later the pedicle is cut and the rest of the flap is fitted in.

deep pocket or depression, lined with epithelium which is continuous with the skin.

A number of operations have been devised by Trautmann, von Mosetig-Moorhoff, and others, for the closure of these fistulæ. The flaps may be varied according to conditions (Figs. 423 and 424).

Retro-auricular depressions which do not connect with the external auditory meatus are treated as follows: The epithelial lining should be completely removed, lateral flaps being formed of its upper portion if the tissue is sufficiently thick to promise successful suturing. The cavity is then filled with a fat, or cartilage graft (my preference is for the cartilage), and the lateral flaps are sutured over the graft. If the



FIG. 425.—Operation for the reconstruction of the external auditory canal (*Bouisson*).—1. A pedunculated flap is raised from the skin behind the ear with the pedicle above. 2. A stitch is inserted in the points A and B and the flap is passed through a buttonhole in the auricle and is sutured into the defect previously prepared to receive it. Thus forming a canal lined with whole-thickness skin. The defect from which the flap is raised is sutured. After ten days the pedicle is severed. The flap is shaped and the buttonhole in the auricle is closed.

are uncertain, then by undercutting with relaxation incisions the skin edges may be approximated. If the defect is wide, it is advisable to use a pedunculated flap from adjacent skin, or from the arm, to close the skin defect.

Reconstruction of the External Auditory Canal

As I have said before, there is little use in trying to form a canal in cases of congenital atresia of the canal accompanied by malformation

the ear. On the other hand, in certain cases of atresia due to trauma, the canal may be occluded at or near its orifice, or be much narrowed by scar tissue. In these instances something should be done to remedy the condition. The simplest procedure but one which is not always successful, is the excision of the scar, with skin grafting of the canal. Ollier-Thiersch or whole-thickness grafts may be used. The skin lined canal is then filled with a paraffin plug, which holds the grafts against the surrounding tissues. The paraffin may be removed after three or four days for observation and cleansing, and should then be replaced. In these cases, after healing is complete, the canal should be frequently stretched to avoid contracture.

Bouisson has devised a method of reconstructing the canal by means of a pedunculated flap from behind the ear. This type of operation is

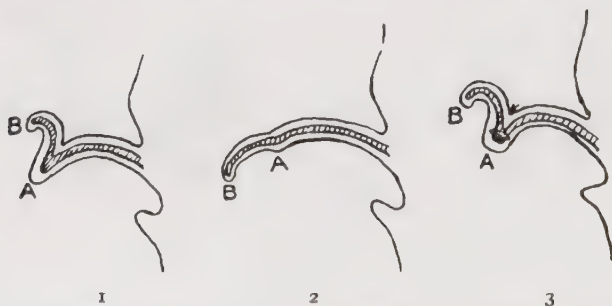


FIG. 426.—Horizontal section of the ear (*Luckett*).—1. Schematic horizontal section of normal auricle just above level of external auditory canal. 2. Schematic horizontal section of a prominent ear showing absence of the cartilage fold which forms antihelix. 3. Schematic section of auricle after reconstruction of antihelix.

probably the best for the purpose and may be modified to suit conditions. Other operations have been done in which flaps from the adjacent skin have been used (Fig. 425).

Abnormal Prominence of the Auricle

Stone divides abnormally prominent ears into *two groups*: In the first, the ear itself is of normal shape, but is attached to the head in an abnormal position. In the second, the prominence is due to an abnormality of the ear itself (Fig. 426).

He calls attention to the fact that many of the malformations of the ear depend upon the shape of the antihelix. There is normally a sharp division between the concha and the fossa above and behind the antihelix and if this is missing the deformity results.

These deformities may be congenital, or may be acquired by young children sleeping with the ear curled up, or by having the ears frequently rolled forward under a carelessly placed cap.

Prominent ears are quite common and the deformity in some instances is so marked that the patient is unable to obtain suitable employment. These ears may be also enlarged, but quite often by changing the angle one can make the size inconspicuous and nothing further will have to be done to correct the macrotia.

Pean's and Monks' Operation for Abnormally Prominent Auricle.—

An ellipse of skin and subcutaneous tissue is removed from the back of the ear and adjacent skin of the mastoid region. This denudation

should be down to the cartilage and to the periosteum. The shape and size of this area depends on circumstances. The skin edges are sutured and the deformity is corrected. This operation is advisable only in cases of very slight deformity, especially in young children (Fig. 427).

Cocheril, Morestin, Faugere, Payr, Kolle, and others, have improved on this procedure by the excision of strips of cartilage in addition to the skin; in this way breaking the resistance of the cartilage and making the result more certain. In some cases more than one piece of cartilage is removed, according to the degree of the deformity.

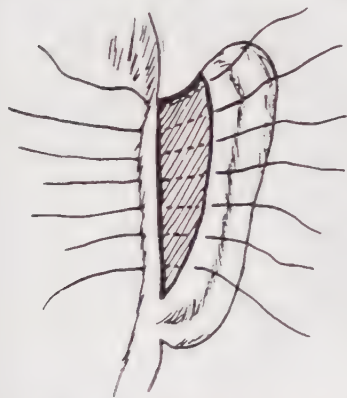


FIG. 427.—Operation for malposition of the auricle (*Monks*).—The shaded area indicates the amount of skin excised. The sutures approximate the skin edges.

After removal of portions of cartilage, the skin on the anterior surface is thrown up into a prominent fold. This fold will often smooth down in due time, otherwise, it can be removed without difficulty at secondary operation. If the denudation back of the ear is too wide or if the spring of the cartilage is not broken, we find the retro-auricular angle almost obliterated. In certain instances of defective auricle on one side due to injury, and a prominent ear on the other, I have utilized the cartilage and skin removed from the prominent ear in the reconstruction of the other auricle.

By the removal of strips of cartilage with turning in of the edge the antihelix and other prominent cartilage landmarks can be reconstructed. Care must be taken to make the two ears symmetrical. The ear should not be made to adhere too closely to the skull. Suture

should not be placed through the cartilage but through the perichondrium, which is quite tough.

Kolle's Operation (with Modifications) for Abnormally Prominent Auricle.—An incision is made through the skin on the back of the auricle, 1.875 cm. ($\frac{3}{4}$ inch) from its free border, from the sulcus above downward to the junction of the retro-auricular skin with that of the neck. Bleeding occurs, and Kolle says that if the ear is pressed back against the head the outline will be marked on the skin, so that the second incision can be made along this line.

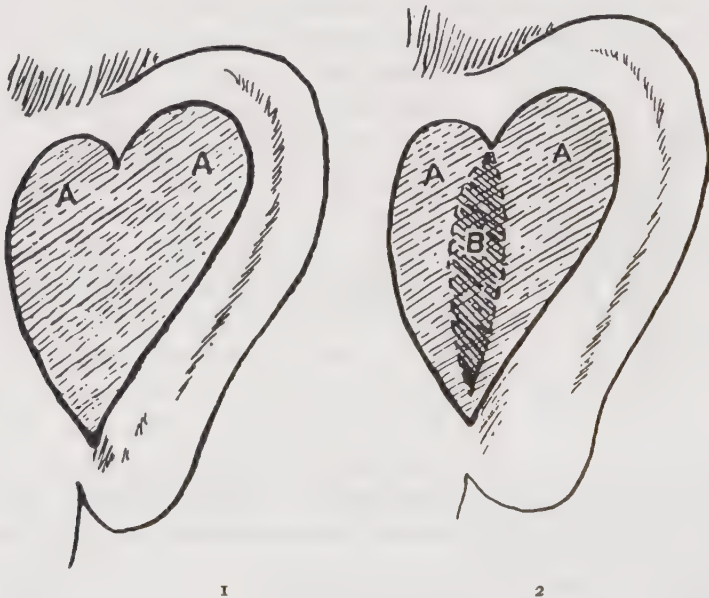


FIG. 428.—Operation for correcting malposition of the auricle (Kolle).—1. The heart-shaped black line indicates the incision for removal of the area of skin and subcutaneous tissue AA, from the ear and scalp. 2. The dotted line indicates the ellipse of cartilage B, to be removed. The surfaces are approximated and the skin is sutured.

My experience has been that this method of marking the incision is impractical, on account of too much bleeding, unless the first incision is very lightly marked out and does not penetrate the full thickness of the skin.

The outline of the entire flap is heart-shaped. This area of skin is removed and should be large enough to overcorrect the deformity. One or more elliptic-shaped pieces of cartilage are removed to relieve tension and, when necessary, to reconstruct the antihelix. The edges of the cartilage should either be approximated or inverted (as the case demands) with fine catgut sutures and the skin with horsehair, the

ends of which should be left long for convenience in removing. Occasionally it is most difficult to check the oozing, and in such cases a small drain of twisted horsehair is placed in the lower angle.

A strip of iodoform gauze moistened with salt solution should be placed over the incision behind the ear, and the anterior surface filled out with damp cotton, thus making a sort of mold which is held in place by a gauze dressing and a bandage. Both ears may be treated in the same way (Fig. 428).

Luckett's Operation for Prominent Ears.—This operation is based on the reconstruction of the antihelix. A crescentic area of skin is removed from the posterior surface of the auricle over the line of the proposed antihelix; the skin edges are undercut and a crescentic area of cartilage of similar size is removed. The cartilage edges are closed in such a manner that they are turned forward, thus forming the antihelix. The skin is closed with horsehair (Fig. 429).

Payr's Operation for Prominent Auricle and Reduction in the Size of the Ear.—This operation will be mentioned only to advise against its use. The size of the ear is reduced in all its diameters by the excision of skin and cartilage. The ear is brought closer to the head by means of a pedunculated flap of cartilage and

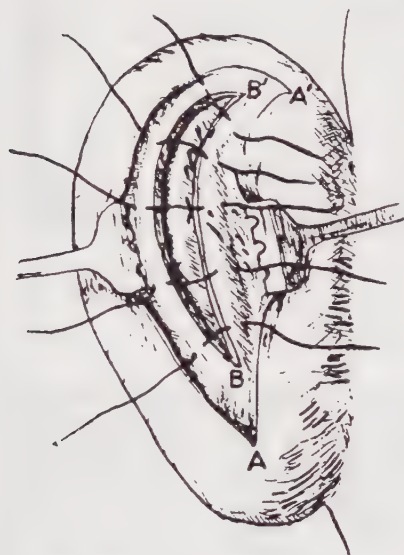


FIG. 429.—Operation for the correction of abnormally prominent ears (Luckett).—AA' shows the crescentic area from which the skin has been removed. BB' shows crescentic area of cartilage removed. The incision has been lengthened and the skin undercut and retracted. Note the method of insertion of sutures to turn forward the cartilage edges to form the new antihelix.

perichondrium which is passed under a loop of periosteum in the mastoid region.

This operation is much more complicated than those previously described and has no advantage over them, except that the ear is reduced in size at the same time that the angle is changed. The reduction in size is seldom necessary. The flap of cartilage is also liable to fracture during the manipulation. The cosmetic results are always very poor.



FIG. 430.—Bilateral prominent lop ears.—1 and 2. Front and back views before operation. 3 and 4. Three weeks after the removal of sufficient skin and cartilage to correct the deformity.

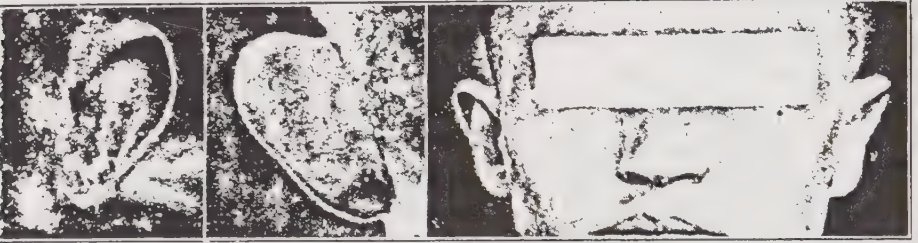


FIG. 431.—Unilateral prominence of the left ear, with absence of the antihelix.—1. The front view of the left ear showing the absence of the antihelix. 2. The posterior view showing the abnormal prominence of the left ear. 3. The result of the removal of skin and cartilage, and the attempt to reconstruct the antihelix. Front view of both ears, taken sixteen months after operation.

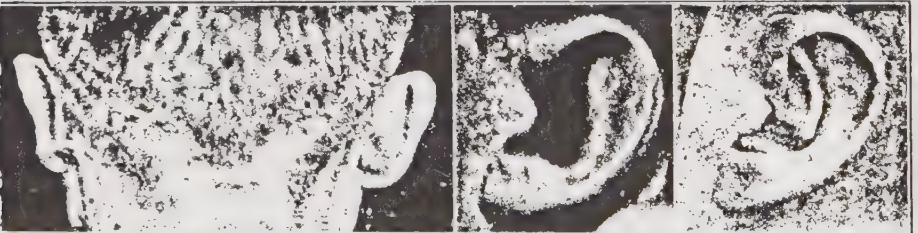


FIG. 432.—Unilateral prominence of the left ear, with absence of the antihelix, *continued*.—1. Rear view of the ears after changing the angle of the left ear and forming the antihelix. Taken sixteen months after operation. The left ear is now more normal in its relationship to the head than the right. 2. The right ear. 3. The left ear showing the newly constructed antihelix.

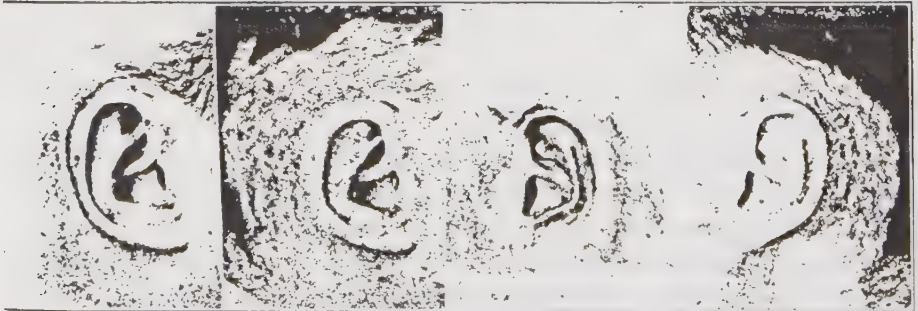


FIG. 433.—Bilateral prominent ears, without absence of antihelix.—1 and 3. Before operation. 2 and 4. After excision of skin and cartilage. Note that the cartilage edges have been united so that there is little abnormal folding.

Smooth, Flattened Ears (without Normal Cartilaginous Ridges)

In some instances we find what may be described as a flattened ear. The curl of the helix is absent, although a suggestion of it may be present, and the angle of the antihelix is also missing. The auricle from the front is a flat surface and the Darwinian tubercle may be present on its

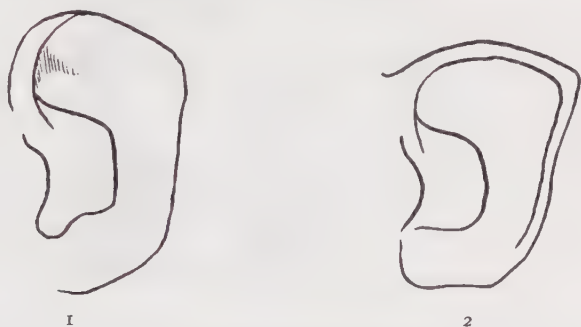


FIG. 434.—Smooth ears.

posterior superior edge. The ear appears larger than the normal ear (Figs. 434-438).

These deformities are corrected by reconstructing the curl of the helix, and the angle of the antihelix. This may be done by excising an ellipse of the skin on the posterior surface of the auricle, and then

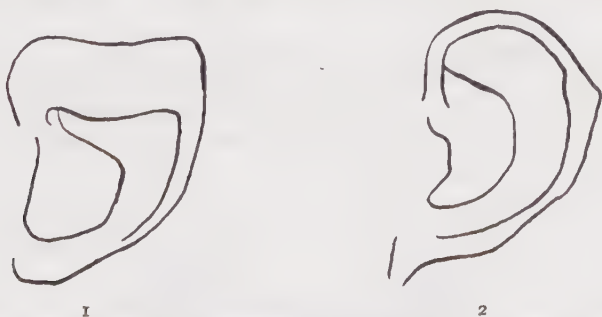


FIG. 435.—Ears with abnormal contours (*Cocheril*).—1. Lop ear. 2. Ear with Darwinian tubercle.

by excision of strips of cartilage and everting or inverting the edges according to whether the skin incision is on the front or back of the ear

It has been suggested to fold the cartilage and hold it in position with sutures, but my experience has been that the spring of the cartilage will eventually overcome the correction, and a recurrence will

allow. It is much better to incise the cartilage or to remove a strip of

Abnormal Contour of the Auricle

In certain degenerates, and also in some apparently normal individuals, the contour of the auricles is abnormal. In an accentuated



FIG. 436.—Lop ear with an accessory auricular appendage on the cheek in front of it.—The antihelix is missing, the rim of the helix is very wide and the ear projects almost at a right angle from the head. 2. The left ear is slightly abnormal in appearance, and projects markedly from the head.

form we find the so-called “lop ears,” and in the less marked conditions the appearance of the Darwinian tubercle. These deformities may be corrected by excision of the skin and cartilage in the selected area and by proper suturing (Fig. 436).

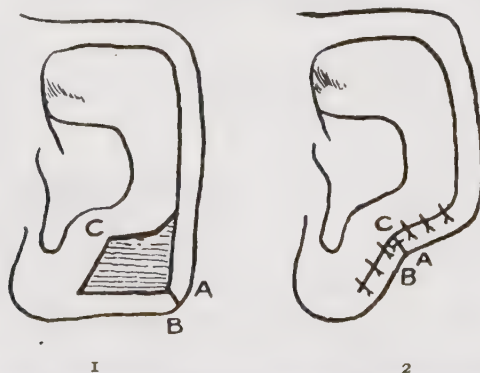


FIG. 437.—Operation for correction of transverse hypertrophy of the lobule (after *Élaton and Ombrédanne*). 1. The flaps A and B are made from the full thickness of the margin of the lobule. A trapezoidal area of tissue is removed. 2. The flaps A and B are sutured to the point C.

Sometimes there is *transverse hypertrophy of the lobule*, in which the width of the lobule is fully that of the widest portion of the auricle.

Nélaton's and Ombrédanne's Operation for the Correction of Transverse Hypertrophy of the Lobule.—The free border of the hypertrophied lobule is incised and a flap is made through the full thickness of the margin on each side, corresponding to the width of the lower portion of the helix. These flaps are later to be used as the border of the ear, after the excision of the trapezoidal piece of tissue from the full thickness of the ear (Fig. 437).

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CHAPTER XIX

SURGERY OF THE EXTERNAL NOSE (RHINOPLASTY)

Plastic surgery of the nose deals with the reconstruction of missing portions and the correction of deformities due either to congenital malformations, disease, or trauma. It must be emphasized that this particular branch of plastic surgery is very difficult, and good cosmetic results are hard to obtain, no matter how simple the defect may seem to be.

Recent Injuries

All wounds of the nose should be sutured after proper disinfection and necessary excision of dead tissue, as scarring and subsequent deformity may in this way be minimized. Where there is extensive loss of tissue every effort should be made to save what remains, especially the columna and alæ, since these portions are difficult to reconstruct. The suturing of skin to mucous membrane in favorable situations will prevent subsequent contraction, and properly placed traction sutures may also be of use. Final reconstruction cannot be accomplished until the wounds have healed.

Replacement of the Nose

Several cases are on record in which a nose which has been completely severed has survived after being replaced and held in position. Although such results may not be the rule, it is always advisable to replace the severed portion (after proper cleansing), and suture it carefully as soon as possible after injury. Should the replaced portion live, the result will be much better than can be expected from any reconstructive operation.

The oldest method of forming a nose was by the use of a free graft from the skin of the buttock. This was done in India before the pedunculated flap from the forehead was tried, and several successful cases have been reported within the last one hundred years. The method of forming a nose from free grafts of skin is extremely uncertain, on

account of insufficient blood supply, the liability to infection, and other accidents, and is scarcely worthy of a trial. In former times noses have

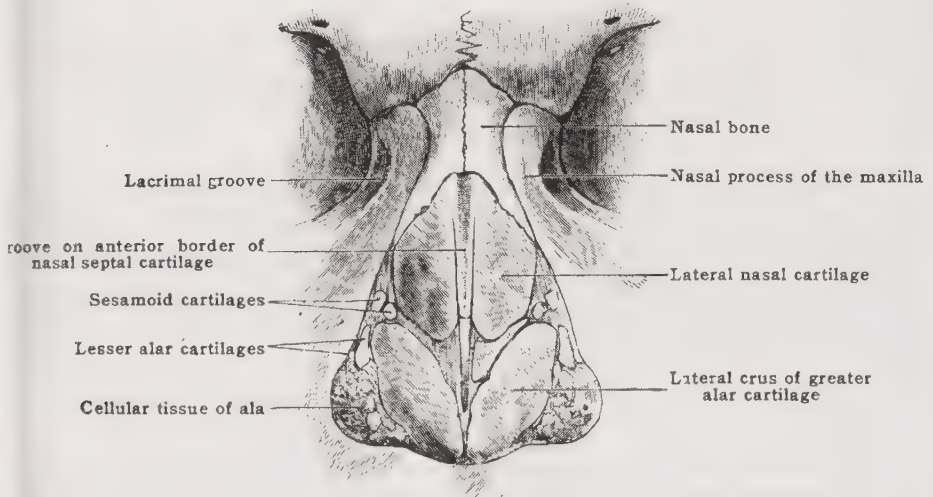


FIG. 438.—Anterior view of the external nose, showing its cartilages (*Morris*).

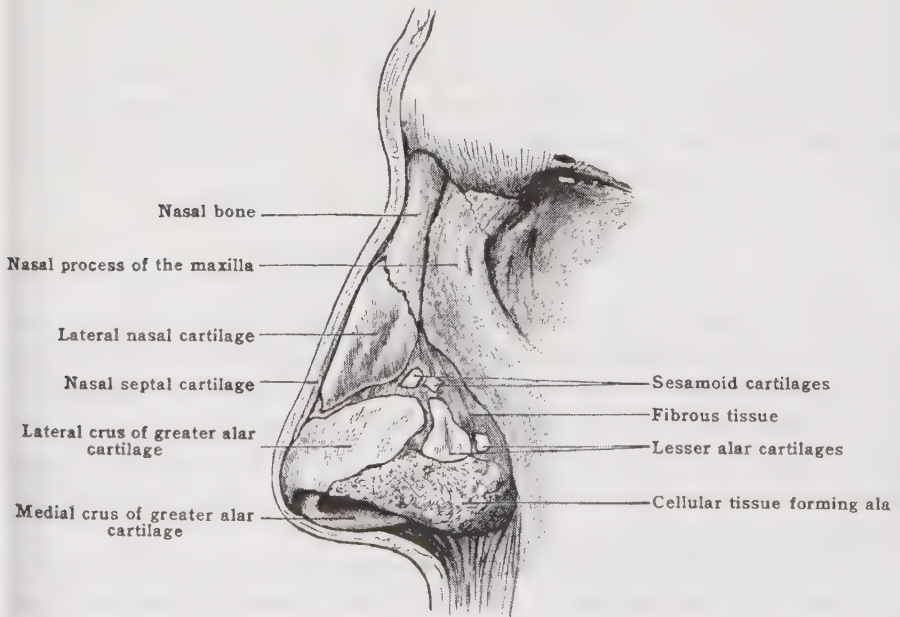


FIG. 439.—Left side of the external nose, showing its cartilages (*Morris*).

been transplanted from one person to another, with a certain amount of success. This method, even if practicable, would be almost impos-

sible to carry out in a civilized community in time of peace, as it is seldom that any individual, however needy, would be willing to part with his nose, but in war time it might be done with little difficulty. My own feeling is that it is practically useless to waste time on this method, as the chances of success are small.

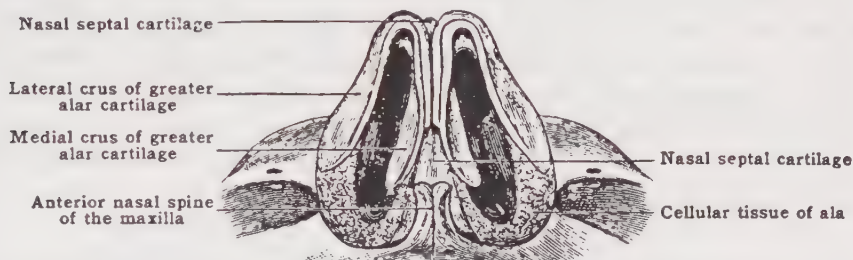


FIG. 440.—Inferior view of the external nose, showing its cartilages (*Morris*).

Losses of Substance

Loss of substance may be on the side or on the bridge of the nose. The destruction may be superficial or through the thickness of the nose, and may be slight or extensive. The superficial destructions are best treated with skin grafts, or with sliding flaps, according to the



FIG. 441.—Operation for the closure of a lateral nasal defect (*Cole*).—1. The dotted line indicates the hinged flap which is turned in and sutured to line the cavity. 2. The flap in position. 3. A scalp flap covering the raw surface. The flaps are closely held together with mattress sutures. Later the pedicles are severed and the ends fitted into position.

situation. If there is perforation and the opening is small, the edge may be turned in and the defect covered with a sliding flap. If the opening is large, a double flap may be necessary from the cheek and forehead, one lining the defect, the other covering the surface. If the defect is on the bridge of the nose, or if the transplanted soft part

in a lateral defect are likely to need support, cartilage must be transplanted between the skin surfaces. For closing these defects I have used folded flaps and also flaps whose under surfaces were grafted, taken from distant parts and from the neighborhood.

In perforating wounds of the bridge of the nose the middle turbinate may be detached posteriorly, and (a pedicle being left in front) placed in the desired position and sutured, after the edges have been freshened (Hett). Both bones may be used in this way if available. The surface is covered with a skin flap after removal of the exposed mucous membrane (Fig. 442).

Recent Fractures

In a recent case of nasal fracture, if the skin is broken, the splintered bones should be molded into proper position by means of a long Kelly

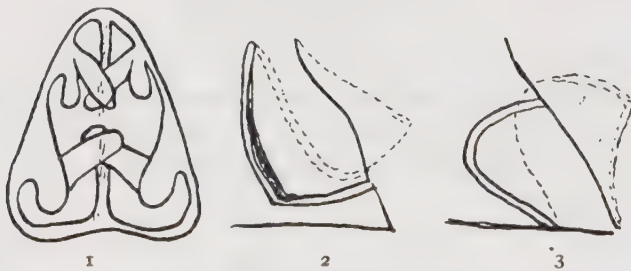


FIG. 442.—The utilization of the turbinates and the septum as supports (Hett).—Method of advancement of the inferior and middle turbinates for purposes of support. and 3. Septal flaps with pedicle above or below, being swung forward for supporting the bridge of the nose.

clamp inserted in the nares. In this way the operator can see the bones and if necessary can suture them into place. The bones should be supported from within the nares on each side by means of a long narrow gauze pack saturated with a thin paste of bismuth subnitrate and castor oil. Gauze saturated with the bismuth mixture will not stick to the tissues; it remains soft and prevents infection. The skin wound should be closed. The pack should be removed after 3 or 4 days.

If the skin is not broken the same procedure is carried out, except that the operator cannot see the bones but must mold them into shape between the clamp within and the fingers outside.

I always prefer a general anesthetic in these cases, as much more effective work can be done. Some operators use metal or hard rubber

splints to support the bones, both within and without, but my preference is for the gauze pack inside and a paraffin cast outside.

Old Fractures

External lateral deflection of the nose following injury is often very disfiguring and makes a deformity that should be corrected. Mosher or Marshall's operations are very effective (Fig. 443).

Marshall's Operation.—Make a very small incision over the nasal process of the superior maxilla near its base. Introduce a narrow chisel through this incision and divide the process without perforating the

nasal mucous membrane. Carry out the same procedure on the other side. Introduce one blade of a heavy septal forceps into the nares, the other being outside, and mobilize the nasal process along its entire length. Do this on both sides and then straighten the septum with the same forceps. If necessary, the junction of the frontal with the upper end of the adjoining nasal bones and processes of the superior maxilla may be fractured with a mallet striking a rubber covered lead plate, the blow being downward and against the deflected side. These bones may

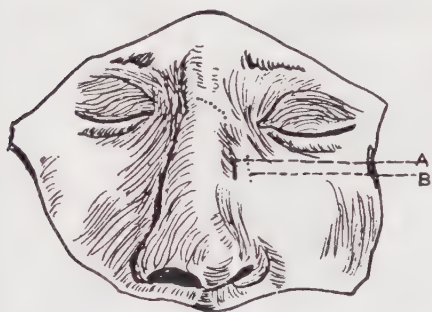


FIG. 443.—Operation for the correction of lateral deformity of the nasal bones following fracture (*Mosher*).—The line A indicates the skin incision through which the bone incisions are made with a chisel. The dotted lines show the bone incisions. This may be done on both sides if necessary.

also be loosened with a chisel through the incision. The nares should be packed with a long narrow strip of gauze soaked in the bismuth and castor oil mixture. No special apparatus is applied externally, but cold compresses are of use in checking the swelling.

I have obtained good results by simply refracturing the nose with a mallet striking against a rubber covered lead plate or a padded wooden block, without chiselling the bones, then straightening it with septal forceps, and packing. The blow should be against the convex side. A plaster cast may be useful in certain cases.

Rhynophyma (*Acne Hypertrophica*)

For the distressing deformities of the nose due to acne hypertrophica radical surgical measures are needed. Place the finger in the nostril

and excise the entire growth down to the cartilage. . Bleeding although severe can be easily checked. The skin at the nostril margin should be conserved as far as possible to avoid subsequent contracture. The defect on the nose may either be allowed to heal by granulation or, preferably, be grafted; otherwise sliding flaps from the cheeks may be used to cover the raw surface. Some remove the growth with the cautery, but this method endangers the vitality of the cartilage and should be used with caution (Fig. 444).

In addition to the swelling and lobulation rhynophyma, I have sometimes seen fissures extending through the cartilage into the nose,

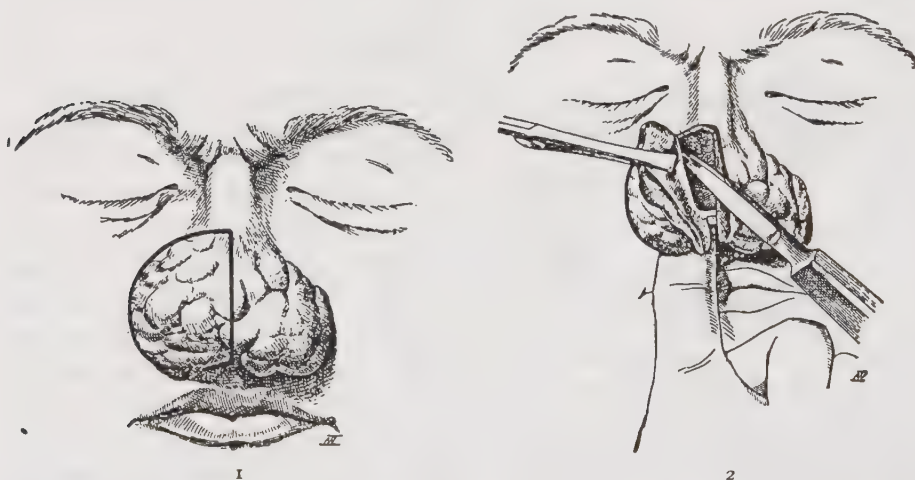


FIG. 444.—Operation for rhinophyma (*Laurens*).—1. The dark line indicates the incision made for the removal of the growth on one side of the nose. 2. The finger is placed in the nostril and the growth is removed down to the cartilage. The raw surface is then skin grafted.

between large pedunculated tumors. In such cases the operation becomes somewhat complicated. The tumors should be completely excised down to the cartilage and the fissured edges of the cartilage should then be freshened and after proper trimming should be closed.

Angioma of the Nose

The treatment of angioma has already been considered in the Section on Congenital Malformations. I might say, however, that in the rare enormous pulsating angiomata involving the nose, it may be necessary to tie off the external carotid on one or both sides; the temporal and the facial arteries and veins on both sides, but even then excision

(which is the method of choice), is difficult and dangerous (Figs. 445-447).

RHINOPLASTIC METHODS

Three general methods are used in reconstructive work on the nose in all of which the blood supply of the transplanted tissue is transmitted through a pedicle.

1. **THE INDIAN METHOD** of taking a flap from the forehead and bringing it into place by twisting the pedicle. The pedicle may or may not be divided subsequently.



FIG. 445.—Hemangioma of the nose and forehead.—Photograph taken when the patient was four years old. Very slight swelling can be noted, although there is a history of bluish discoloration beneath the skin. There was gradual increase in the size of the growth until two years before her admission, when more rapid growth occurred. On admission the huge growth pulsated, and a loud systolic thrill could be heard over the nose and on the forehead as far out as the temporal regions. Before the patient came under my care both external carotid arteries and some of the nasal vessels had been tied. The only result was the disappearance of the thrill. (See figures 446 and 447.)

2. **THE FRENCH METHOD** of sliding flaps from adjacent tissue normally without twisting the pedicle. The pedicle is seldom if ever divided, unless a secondary shifting is necessary.

3. **THE ITALIAN METHOD** of using a flap from the arm, or other distant part, the pedicle being severed after from ten days to two weeks.

Many combinations of these methods have been devised, and in addition skin grafting is frequently necessary. All of the operations to be described have been modified many times, but the principles have remained the same.

The choice of method depends on the degree of destruction, the dimensions of the flap required, the presence or absence of scar in the

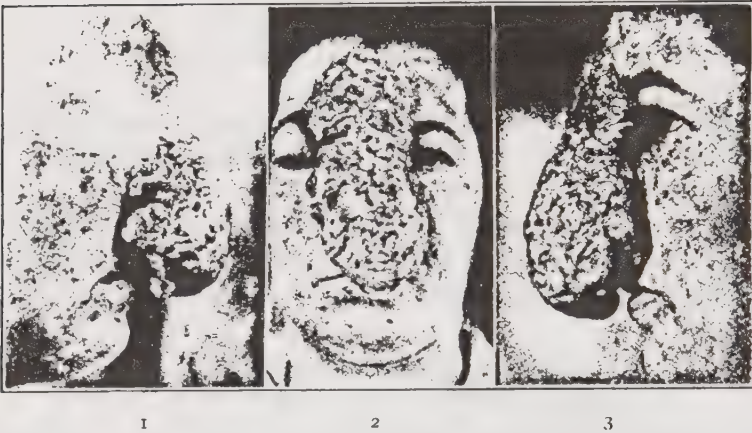


FIG. 446.—Hemangioma of the nose, *continued*.—1, 2 and 3. Photographs taken when the patient was seventeen years old, and after pulsation had ceased. Note the extent of the growth and the horrible deformity. Spontaneous hemorrhages were frequent and on several occasions almost exsanguinated the patient before the bleeding could be checked. Huge blood channels were found on operation and some were as large as a lead pencil and led directly through into the skull. Radium was used without benefit. There was such marked hemorrhage during any operation on the growth that an attempt was made to form scar tissue through the growth in order to make operative procedure possible. This was accomplished by the injection of equal parts of formalin, glycerin and 90 per cent. alcohol, as advised by Morestin, and by the injection of boiling water. Multiple punctures with the Pacquelin cautery were also tried. Finally sufficient scar tissue was produced to allow operative interference without excessive hemorrhage. Then gradual partial excision was undertaken.



FIG. 447.—Hemangioma of the nose, *continued*.—Shows the result of excisions to date. The spontaneous hemorrhages have ceased and the condition is considerably improved. Much more will be done for this patient, and eventually we may hope for a nose which will not be especially conspicuous.

surrounding skin, the age and condition of the patient, and the importance of minimizing the scars made upon the face.

It must be emphasized that, in cases in which the framework of the nose has been destroyed, it is useless to attempt reconstruction with either single or double (external and internal) skin flaps, unless these flaps are supported by a framework.

In all flap operations it is essential to calculate the size and shape of the flap to be used by means of a pattern made of some material which is flexible and can be sterilized. For this purpose thick rubber-dam is most suitable. The flap should be at least one-third larger than the defect it is to cover.

It is very much better to raise a flap which is considerably over-size than one which is too small; excess tissue can always be removed. The most advantageous position of the pedicle should also be determined.

Great technical difficulties are encountered in carrying out many of the reconstructive operations on the nose, especially in handling flaps with broad films of bone attached. Judging from the diagrams an inexperienced worker might be led to suppose that the entire process is simple and may be completed in one or two operations, but this is far from the fact. In many instances from twenty to thirty (mostly minor operations), are necessary before the desired result is obtained. Obviously it is difficult to avoid infection in many rhinoplastic operations, and this is always a serious complication.

In a properly cut flap from the forehead the blood supply is perfect and it is often necessary after rotating the flap to tie off spurting vessels in the tip of the free border. Sensation is referred to the forehead until the pedicle is cut.

Before reconstruction of the nose is attempted, care must be taken to remove all scar tissue which obstructs the pyriform opening

It is often advantageous to form the nostrils and build the nose over nasal splints attached either to a band around the forehead or, better still, to a dental plate. This apparatus is allowed to remain in place as long as necessary and is so arranged that the nostril splints may be readily removed and replaced.

Anesthesia.—In all extensive operations a general anesthetic should be used. Many of the less formidable procedures can be done under local anesthesia, either by the infiltration method, or by blocking.

Preparation.—The nose and throat should be sprayed with Dobell's, Boulton's, Dichloramine-T, or some other antiseptic solution, every three hours for several days before operation.

All hair is shaved, or clipped close where shaving is impossible. The skin is cleansed with ether or benzin. Crusts are removed. The

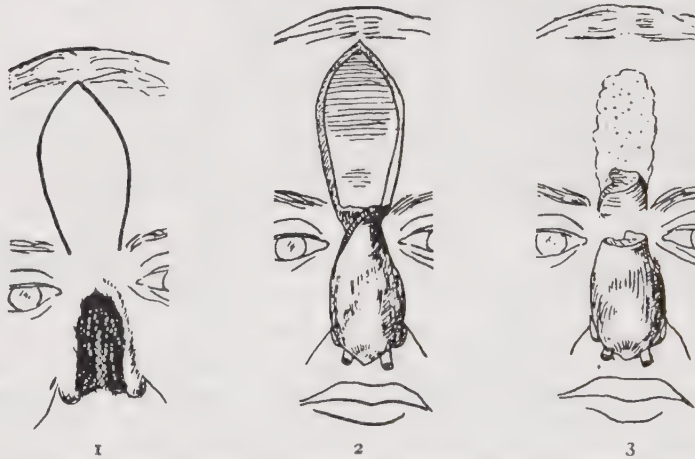


FIG. 448.—The Indian method.—Operation for restoration of complete loss of nose.—
1. Outline of oval flap. Note position of pedicle. 2. Flap turned through 180 degrees, to bring it into position with skin surface outward. Note tip of flap attached to upper lip to form the columna. 3. Pedicle severed after 10 to 14 days. The pedicle end should be turned back into its normal position. The flap end should be utilized on the bridge of the nose.



FIG. 449.



FIG. 450.

FIG. 449.—Operation for complete loss of nose (*Lisfranc*).—Note the shape of the flap. The incision on one side is lower than the other, and in this way the torsion of the pedicle is somewhat lessened. The margins around the nasal defect are dissected up, and the edges of the flap are inserted in this groove.

FIG. 450.—Operation for complete loss of nose (*v. Graefe*).—Note the rectangular projection at the upper border which is to be used to form the columna.

exposed mucous surface is washed with salt solution and dried. Finally the skin and mucous membranes are painted with one-third strength tincture of iodine.

Indian Method

The use of the forehead flap by the Indian method is the basis on which all subsequent improvements in rhinoplastic operations have been made.

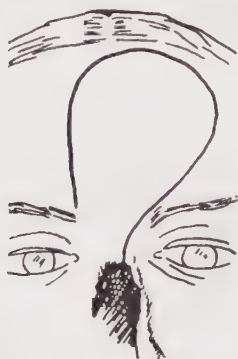


FIG. 451.

FIG. 451.—Operation for complete loss of nose (*Petralli*).—An oval flap is raised and its extremity is folded on itself to form the columna.



FIG. 452.

FIG. 452.—Operation for complete loss of nose (*Forgue*).—The flap differs in shape and the pedicle is much wider than in the usual operation, extending from the middle of the eyebrow to the midline of the nasal defect.

The pedicle is usually located between the inner ends of the eyebrows; it should be from 2. to 3. cm. ($\frac{3}{5}$ to $1\frac{1}{5}$ inches) wide and include



FIG. 453.

Fig. 453.—Operation for complete loss of nose (*Delpech*).—This differs from the Indian operation only in the trident shape of the free extremity. The central tongue forms the columna, and the lateral tags line the alæ.



FIG. 454.

Fig. 454.—Operation for complete loss of nose (*Landreau*).—The flap is transverse and the base of the pedicle is upward. A flap cut in this way eliminates the torsion.

the arteries on each side of the nose. After the proper pattern has been designed, and the situation from which the flap is to be raised has

been selected, the outline can be marked out with nitrate of silver stick the day before, or with a scalpel at the time of operation, along the edges of the pattern. The flap in the original Indian operation was oval and vertical, and was twisted 180° to bring it into position.

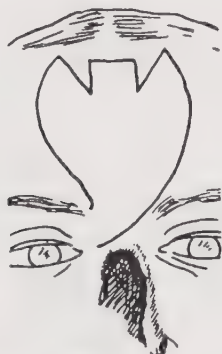


FIG. 455.

FIG. 455.—Operation for complete loss of nose (*Langenbeck*).—The shape of the superior border of the flap and the pedicle is curved, the left lateral incision being very close to the nasal defect.

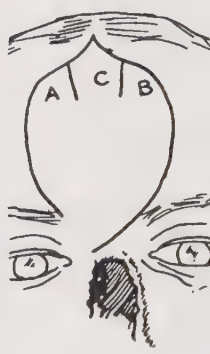


FIG. 456.

FIG. 456.—Operation for complete loss of nose (*Labat-Dubowitzky*).—Note the shape of the flap and the position of the pedicle. The flaps A and B are turned under to line the ala. The flap C is folded on itself longitudinally, and sutured to form the columna.



FIG. 457.

FIG. 457.—Operation for complete loss of nose (*Alquié*).—The flap is transverse. The pedicle is downward.

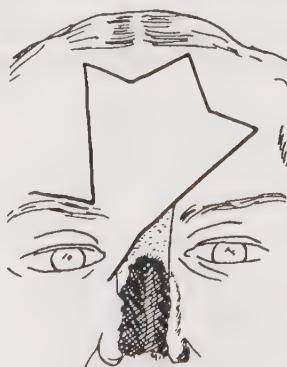


FIG. 458.

FIG. 458.—Langenbeck's second operation for complete loss of nose.—The flap is oblique. The skin between the pedicle and the nasal defect is removed.

Many modifications have been made in the shape and direction (horizontal or oblique) of the flap, and the position of the incisions which mark out the pedicle. The operation is usually done in one, but it may be done in two stages (*Linhart*, *Szymanowski*).

Diagrams of the various shapes in which flaps have been cut, and the position of the pedicles will be shown, in order to supply suggestions which may be of use in selecting the type of flap desired.

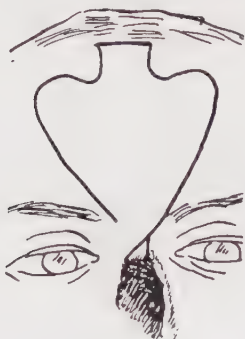


FIG. 459.



FIG. 460.

FIG. 459.—Operation for complete loss of nose (*Labat*).—Note the shape of the flap, and the formation of the pedicle. This lessens the torsion of the pedicle, and the small triangle of skin at the root of the nose is dissected up, and turned down to form the lining of that portion of the frontal flap.

FIG. 460.—Operation for complete loss of nose (*Auvert*).—The frontal flap is made at an angle of 45 degrees, and the left incision forming the pedicle enters the nose defect at the midline.

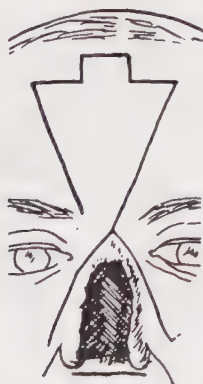


FIG. 461.



FIG. 462.

FIG. 461.—Operation for complete loss of nose (*Dieffenbach*).—The flap is cut wider at its upper extremity than in *Lisfranc's* operation. The remains of the nose are either removed or turned inward to line the edges of the frontal flap. The rectangular extremity of the flap is inserted in the transverse incision just below the nasal defect.

FIG. 462.—Operation for complete loss of nose (*v. Ammon*).—This operation is much the same as that of *Dieffenbach's*, except that the shape of the flap is different.

For the reconstruction of the nose the Indian method is bad in principle and the results are poor. It is not possible to bridge a

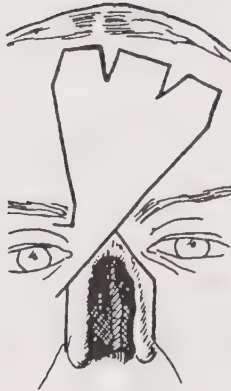


FIG. 463.

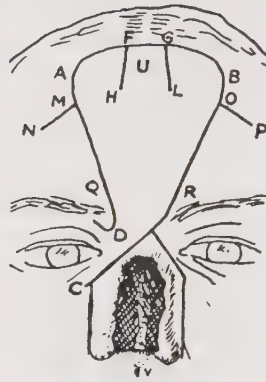
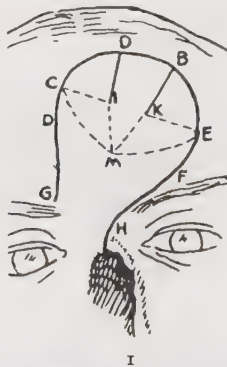


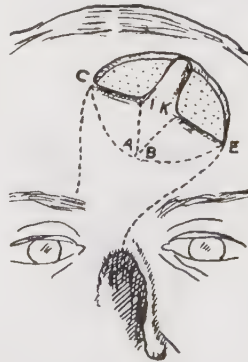
FIG. 464.

FIG. 463.—Langenbeck's third operation for complete loss of nose.—This differs in the shape of the flap, and in the incisions forming the pedicle. The margins of the nasal defect may either be removed or turned in.

FIG. 464.—Operation for complete loss of nose (*Szymanowski*).—This is also a two-stage operation. Trace and raise the flap DABC. Then make the incisions FH and GL. This forms the flaps AFH and GLB, which are turned under and secured. Fold the septum (columna) flap U on itself lengthwise. Return the flap to its bed. In from 10 to 14 days freshen the edges of the nasal defect, or turn them in. Raise the flap and suture it into position. In order to close the forehead defect the incisions MN and OP are made, and if the skin is lax the edges OR and MQ may be approximated.



1



2

FIG. 465.—Operation for complete loss of nose (*Labat-Blasius*).—1. The outline of the frontal flap is cut with the exception of the areas between AB, CDEF and GH. The sides of the future columna AI and BK are incised. Then the flaps AIC and BKE are turned under and sutured in the position indicated by the dotted lines CIM and EKM. 2. After the inturned flaps have healed (10 to 14 days), the entire flap is raised, the portion AB is folded lengthwise on itself, and the flap is transplanted. This gives a lining to the nostrils before the flap is shifted.

large defect with an unlined flap without support and have it retain any resemblance to a nose after shrinkage has taken place (Fig. 448-467).

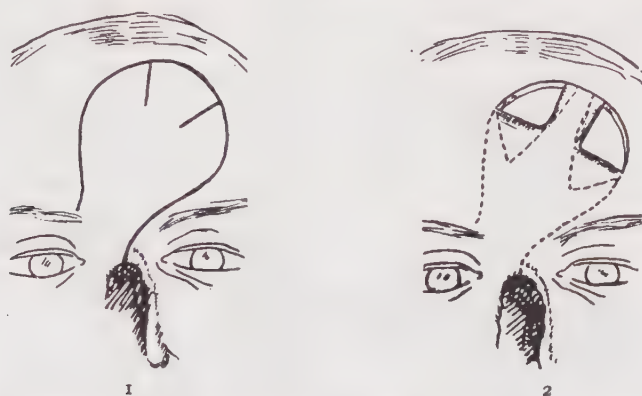


FIG. 466.—Operation for complete loss of nose (*Linhardt*).—This operation is quite similar to the Labat-Blasius operation, and is done in two stages, the flap being turned under in the same manner. The advantage is that the oblique incisions form the alæ which are less thick, the nostrils are not so narrow, and the septum (columna) is better formed.

The French Method (The Method of Celsus)

Sliding flaps from adjacent tissue should not be used alone in total nose reconstruction. I have found the method very valuable however.

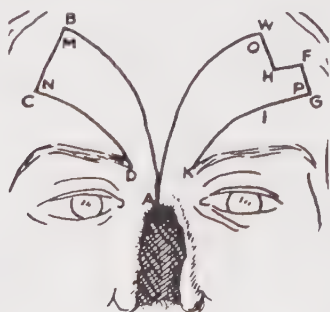


FIG. 467.—Operation for complete loss of nose (*Blasius*).—This double lateral front flap operation is extremely useful at times. The flaps DCBA, and KGFWA, are dissected up, and turned downward and inward, so that skin surface is outward. P is in the middle to form the columna. N is sutured to the base of P. The points M and O form the outer ends of the alæ.

in the repair of smaller defects, and when used in conjunction with the other methods, in forming a lining for the defect or in covering the raw surface of another flap (Fig. 468).

The Italian Method

The history of the development of this method has been considered in another section. A pedunculated flap from the arm, applied with raw surface inward, was first used by Tagliacozzi; later on by Fabrizio and others, the forearm was utilized. The transfer has been made from the chest, or abdomen, to the forearm (Steinthal), and then to the nose. Another modification is the transfer of a flap from the breast (in women)



FIG. 468.—The restoration of the nose by the use of cheek flaps.—1 and 2. The condition of the nose following the application of "cancer paste." Two unsuccessful attempts were made by me to repair this defect with a flap from the arm. 3 and 4. The repair was made in numerous operations by the use of flaps from the cheeks and by the gradual shifting of these tissues with skin grafting, so that the defects were filled with lined flaps. Photograph taken one and a half years after discharge from the hospital. A forehead flap could have been used in this case.

directly to the nose (E. Höllander); from the shoulder or clavicular region directly to the nose (Mandry, Aymard, and others).

The use of a single unlined and non-supported flap, transplanted by this method is not advisable for the reconstruction of a total loss of nose, but in the reconstruction after partial loss it is invaluable in selected cases.

Several complicated pieces of apparatus for holding the parts in position have been devised, but as each individual differs in size, and as the desired position varies, these set pieces are not advisable, although an apparatus may be specially constructed for certain cases.

Numerous methods of supporting the arm have been suggested. In my own experience a plaster-of-Paris cast has been the most satisfactory, although its proper application is difficult when the patient is

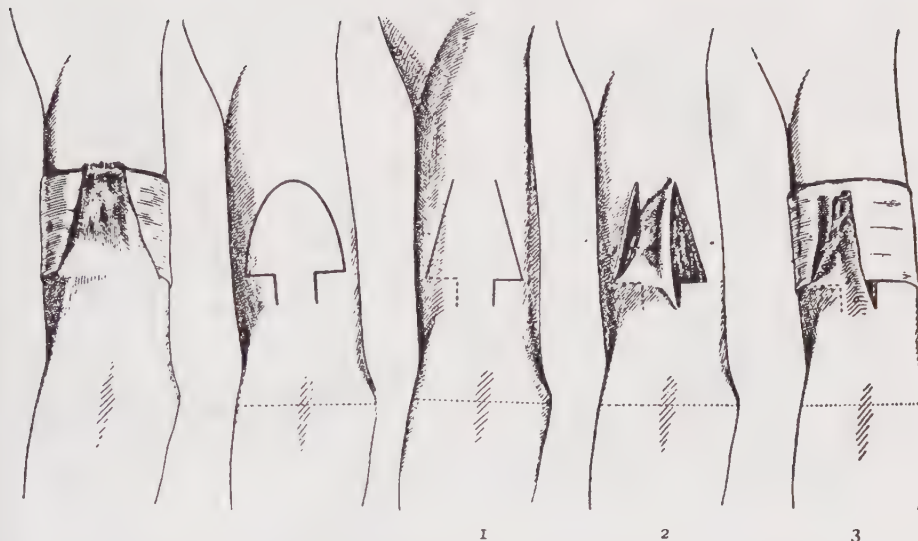


FIG. 469.

FIG. 470.

FIG. 471.

Methods of forming flaps from the arm (after Nélaton and Ombredanne).

FIG. 469.—*The Method of Tagliacozzi*.—The flap is left attached at both ends, being held from its bed by rubber protective. The upper pedicle is severed after 3 weeks, and transplanted.

FIG. 470.—*The Method of v. Graefe*.—The flap is raised and transplanted to the nose immediately. The pedicle being severed from the arm 10 to 14 days later.

FIG. 471.—*The Method of Dieffenbach*.—1, 2 and 3. Incisions are made as indicated by the solid lines. The flap is raised from the arm but is left attached at both ends. It is then folded on itself lengthways, and sutured to the free edge on the opposite side. Then after several weeks the upper pedicle is cut, the double-faced flap is opened, and sutured to the freshened nasal margins. Two weeks later the pedicle on the arm is cut.



FIG. 472.—Operation for the reconstruction of the nose by the Italian method (*Fabris*).—A triangular flap with its base transverse is raised from the anterior outer portion of the forearm. It is sutured into the freshened edge of the nasal defect. The hand is placed on the opposite shoulder and secured. Two weeks later the pedicle is severed, and after several days the nose is shaped.

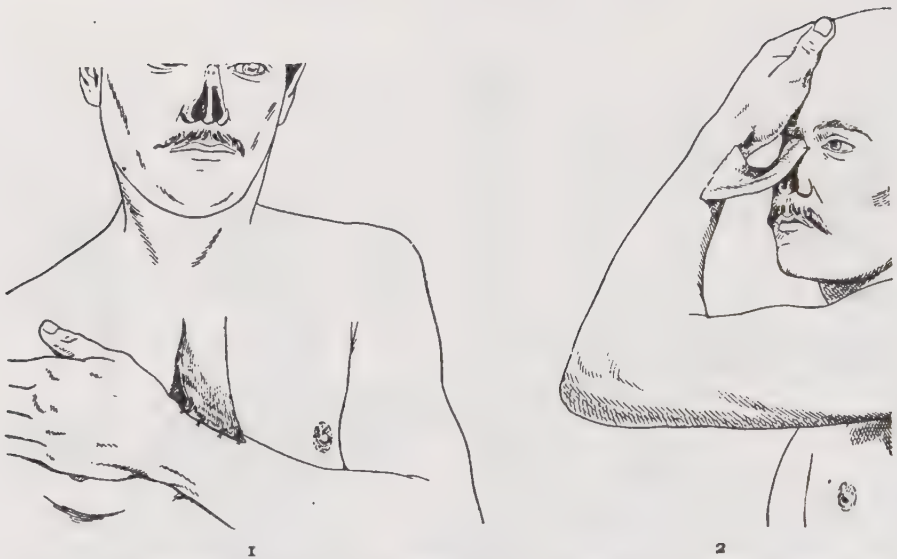


FIG. 473.—Operation for the reconstruction of the nose by the Italian method, with double transfer (*Steinthal*).—1 and 2. A flap is raised from the chest wall and its free extremity is sutured into an incision on the radial side of the wrist. After two weeks the pedicle is severed, and the free end is immediately sutured into the freshened nasal defect. The hand rests against the forehead. Two weeks later the flap is cut away from the wrist.



FIG. 474.—Operation for total rhinoplasty (*E. Holländer*).—1. Shows the outline of the flap on breast and chest. The base is just above the areola, the free end is upward. 2. The breast pushed upward, and the flap in position. The pedicle is severed after ten to fourteen days. Any desired cartilaginous supports could be implanted before raising the flap.

under a general anesthetic. In cases in which the operation is done under a local anesthetic, the application of the cast is much easier, as the patient can hold the arm in position while the cast is being applied. The body of the cast may be prepared and fitted on before operation if desired.

In using plaster of Paris great care should be taken to pad the part sufficiently. The plaster may or may not be reinforced with metal strips or woven wire. The cast may be later cut away to the minimum amount necessary for support. At best all methods are uncomfortable but I have found that children, after the first day or two, become quite reconciled to the enforced position necessary, although it must be confessed that the whole process is very trying to all concerned.

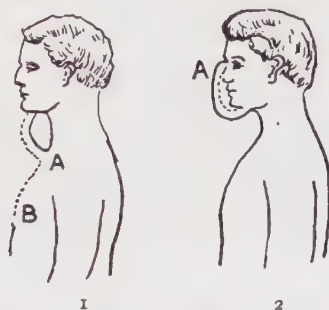


FIG. 475.—Double transfer of a flap from the chest in rhinoplasty (A. Rosenstein).
1. The flap raised from the chest wall with pedicle A, in the clavicular region. The free end is implanted under the chin. The flap should be longer than the neck to avoid tension.
2. The pedicle is cut and the free end implanted in nasal defect. Subsequently the pedicle is cut away from the chin.

I often remove the cast after a few days, and replace it with reinforced crinoline, which is lighter. There is a certain risk of embolism when the arm is set free, but so far I have been fortunate enough not to encounter this accident.

There is always more or less infection, for it is extremely difficult to keep the supporting apparatus clean, and it soon becomes offensive. The advantages of the method are that there is no scarring of the face and that normal tissue can be transplanted.

The Double-flap Method

After failure to get results with a single flap, irrespective of the method used, the next advance in technic was in the use of a double flap, one flap with the skin surface inward to line the nose and another

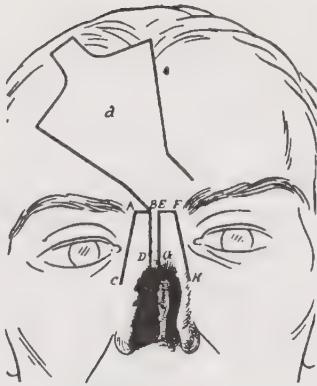


FIG. 476.

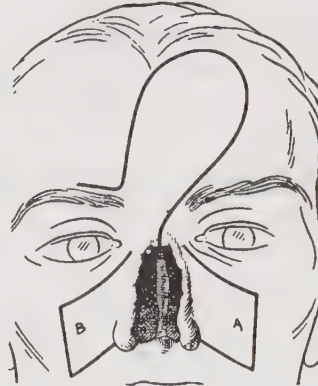
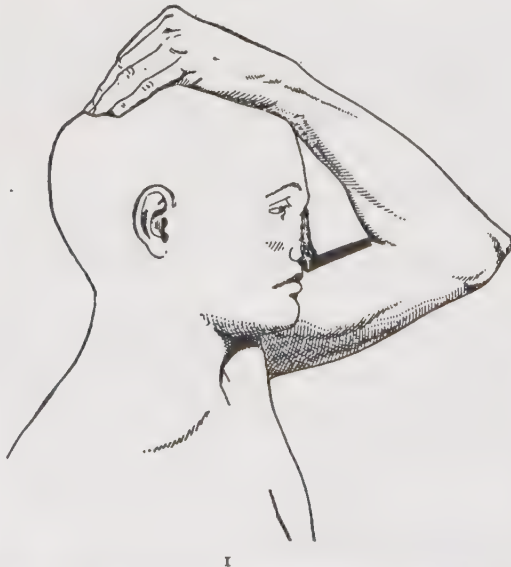


FIG. 477.

FIG. 476.—Operation for the reconstruction of the nose by the modified Indian method (Keegan).—The flaps CABD, and GEFH, are raised and turned down. (There is no necessity of having a space between these flaps.) Where they overlap, Smith, instead of trimming the edges (as Keegan does) inserts the flap as a scroll, raw surface to raw surface, and after splitting the old septum from the insertion of the original columna upward, he stitches each one into its respective side of the split septum, and brings the raw surfaces together with a few sutures, thus forming a septum as well as a lining to the nose. The forehead flap is then brought down and fitted as usual.

FIG. 477.—Operation for the reconstruction of the nose by the modified Indian method (Thiersch).—The flaps A and B with base adjacent to the nasal defect are raised, reflected, and sutured together in the midline, epithelial surface downward. Then the frontal flap is brought down to cover the raw surface. The nostrils are formed and the skin defects are either sutured or skin grafted.



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2

FIG. 478.—Operation for the reconstruction of the nose by the combined Italian and Indian methods (Küster).—1 and 2. A flap is raised from the inner anterior portion of the forehead with its base upward. It is sutured into the nasal defect with skin surface inward. The pedicle is severed after from 10 to 14 days, and the raw surface is covered with an anterior flap from the forehead (or with a skin graft).

with the skin surface outward to cover the flap first applied. The reconstruction of a total loss of nose by this method, although an improvement on the single flap, is also unsatisfactory without the employment of a proper support.

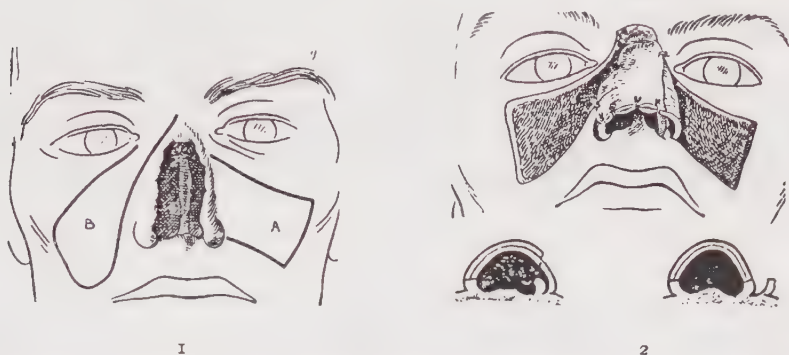


FIG. 479.—Operation for the reconstruction of the nose (*Helferich*).—1 and 2. A flap A with its base adjacent to the loss of substance is raised from the cheek and turned over skin side downward, and is sutured to the freshened edge of the nasal defect on the opposite side. Care is taken to utilize the stump of the ala. Then the flap B with its pedicle above is raised, and shifted to cover the raw surface of flap A. Two weeks later the lower portion of the pedicle of the internal flap is cut, and is sutured to the freshened stump of the ala on that side. The cheek wounds are grafted. The inserts indicate the positions of the flaps.

In the operations devised by Keegan, Thiersch, Helferich, Küster and Berger, as shown in the diagrams, we have the best of the methods for the formation of double flaps (Fig. 476-481).



FIG. 480.—Operation for the reconstruction of the nose (*Berger*).—1 and 2. A flap outlined is raised, turned down, and sutured to the freshened border of the nasal defect.

A double flap may also be made by turning on itself a flap from the arm. After union of the raw surfaces, the edges are freshened and the flap is implanted into the defect. This method will be illustrated later in an operation of the author's for the repair of a cheek defect.

The flap may be lined with skin by grafting the under surface

either with Ollier-Thiersch, or with whole-thickness grafts, by the open or by the buried methods, and allowing healing and shrinkage to take place before the flap is transplanted.

Reconstruction of the Framework of the Nose

There are *two methods* of making a framework for the nose. In one we make use of *inorganic materials*, which may be removable, or may be buried. Prosthetic apparatus has already been considered, but I might again say that the use of buried *inorganic* supports is inadvisable. In certain instances removable supports may be considered advanta-

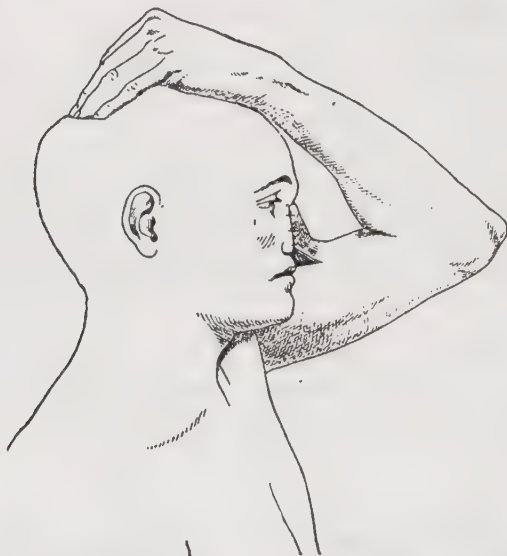


FIG. 481.—Operation for the reconstruction of the nose, *continued*.—A flap with its pedicle toward the elbow is raised from the anterior surface of the arm, and is sutured into the forehead defect, and covers the raw surface of the turned down flap. The arm is secured, and after 10 to 14 days the pedicle is cut and the nose is shaped.

geous where there is a curtain of skin which covers the defect, but as a general rule the framework of the nose should be made of organic material.

In the second we make use of *organic materials*. *Periosteum alone* included in the flap from the forehead (Ollier, 1864) for the formation of a framework is said to be satisfactory in certain cases, as bone may be formed (if bone spicules are detached with the periosteum), but when transplanted free, my experience, experimental as well as clinical, has been that bone is never formed and that consequently periosteum is of little use in the formation of a support.

BONE AND CARTILAGE.—The bone may be obtained from the frontal region, the ribs, tibia, or clavicle. The bone transplant may be separated from the underlying bone without being detached from the overlying soft parts. This is the safest method. The transplant may be free, but my experience has been that a free bone transplant in soft parts will eventually be absorbed and, when in contact with bone at only one end, it will eventually atrophy.

Cartilage may sometimes be obtained by submucous resection of a portion of the septum, but is usually secured from the cartilaginous ribs and is always transplanted free. This material is best for the purpose and it will be noticed, in following certain operators' work that those who begin with the use of bone will eventually turn to cartilage as the best material for the construction of a framework for the nose.

Cartilage should be suitably shaped and lateral supports properly placed. It may be implanted between the layers of a double flap, by burrowing, after the flap has been sutured into position and has healed it may be placed between the flaps at the time of their transplantation or better still, the cartilage may be inserted in the desired position under the proposed lining or covering flap, until it is established, and then transplanted with the flap.

Transplantation in Children.—The advisability of transplanting bone or cartilage as a nasal support in children is still undetermined. After considerable experience with bone and cartilage transplants in rhinoplasty, my conclusion is that these transplants do not grow in length, in fact the tendency of the bone is to shorten, and the cartilage remains its original length. As the child grows the new nasal support itself will not increase, although it may apparently do so, at an equal rate with the bones on which it impinges.

The question arises, should one wait until full growth has taken place, or should the operation be done early? My own opinion is that the support should be inserted quite early, to prevent as far as possible shrinkage of the skin, but there should be slight over-correction. Then if conditions demand further work after the growth is complete, we have a better chance of permanent success, as the skin is already stretched. This applies especially to those cases of congenital lues with saddle nose, or to early flattening of the nasal bones from trauma.

Rhinoplasty with Osteo-periosteal Support

The operations for the construction of a nose by means of a flap from the forehead including a piece of the underlying bone with its periosteum, was devised by König, in 1886. Since that time a number

of modifications have been made in carrying out the method. Those by Helferich, Schimmelbusch, and Lexer, being among the best.

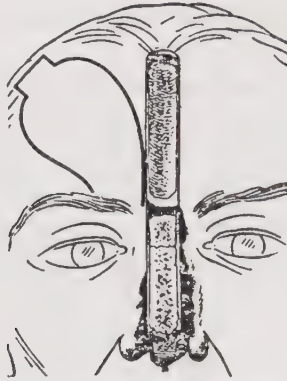


FIG. 482.—Operation for the reconstruction of the nose (*König*).—A flap 1 cm. ($\frac{2}{5}$ inch) wide consisting of skin and a thin layer of bone with its periosteum is raised from the midline of the forehead. Its pedicle is at the root of the nose, and its free end extends into the hairline. The flap is turned down, skin surface inside, the bone is fractured at the point to be the tip, and the end of the flap is bent inward, and the extremity is sutured to the upper lip. The skin surrounding the nasal defect is dissected up toward the midline, and turned in and sutured to the median flap. An obliquely planned pedunculated flap without periosteum, is raised from either side of the forehead, and is twisted to cover the raw surfaces of the flaps turned in to line the nose. Several secondary trimming and shaping operations are necessary.

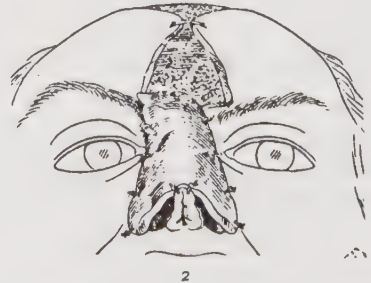
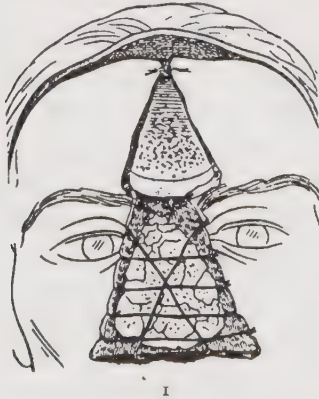


FIG. 483.—Operation for the reconstruction of the nose (*Schimmelbusch*).—1 and 2. A triangular flap of skin, periosteum and bone is raised from the forehead. The pedicle which is 3 cm. ($1\frac{1}{2}$ inch) wide, is between the eyebrows and the base, 6 to 9 cm. ($2\frac{2}{5}$ to $3\frac{3}{5}$ inches) wide, is near the hairline. The bone is raised in one sheet if possible. The forehead defect is then closed by large sliding flaps whose upper borders follow the hairline. The flap is allowed to granulate and is then grafted (immediate grafting is preferable). Then, after healing is complete, the bone is sawed into halves through its grafted surface. The flap is turned over, grafted side in, and sutured to the freshened edges of the nasal defect. The columna can be planned for in cutting the forehead flap, but otherwise can be made of two flaps of skin from the margins of the pyriform opening, as shown in the diagram.

Israel described an operation in which a flap raised from the forearm included a piece of the ulna for support. Gustav Mandry uses a flap which includes a strip of bone from the sternal end of the clavicle.

Free bone has also been transplanted between the surfaces of a double faced flap, but this is never as satisfactory as when the bone has not been separated from its overlying soft parts.

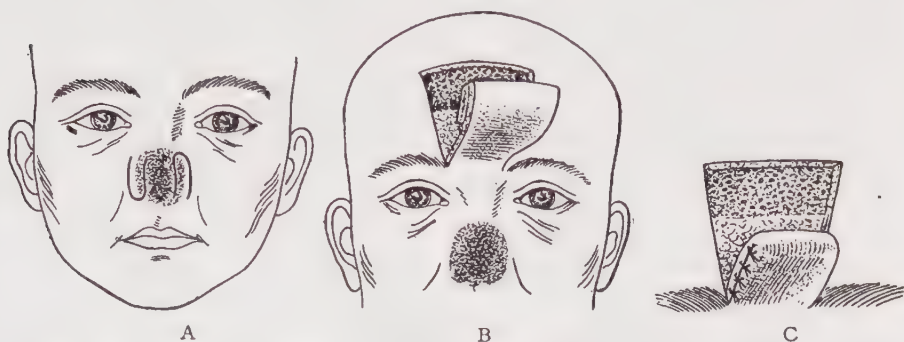


FIG. 484.—Lexer's operation for the restoration of total loss of the nose (*Binnie*).—Remove all scar obstructing the pyriform opening and cover the raw surface with flaps from adjacent skin, being sure not to use that just above the opening. A broad skin osteoperiosteal flap is raised from the upper half of the forehead and is turned down to be covered by the lower portion of the flap which contains no bone (Fig. 484B). Cover the forehead wound with Ollier-Thiersch or whole-thickness grafts (Fig. 484C).

Rhinoplasty with a Cartilaginous Support

Von Mangold, in 1899, first used a piece of costal cartilage for a supporting framework, and since that time much use has been made of free grafts of costal cartilage.



FIG. 485.—Lexer's operation for the restoration of total loss of the nose, *continued*.—Three to four weeks later the incisions which outline the pedicle are gradually lengthened a little at a time, until the inner angle of the eye is reached on one side, and the nasal opening on the other (Fig. 485A). Through the latter incision separate the skin from the root of the nose until the midline is reached, and it becomes possible to twist the pedicle into position without tension. From the under surface of the flap raise a narrow skin flap to form the column, and through the same incision divide the bone longitudinally and fold it like a roof (Fig. 485B). Freshen the edges of the nasal defect and suture the flap into position.

The cartilage may be implanted in the proposed frontal flap, above or below the periosteum, and allowed to remain for several weeks before

the flap is raised. Ordinarily quite a narrow piece is implanted, but one or more wide pieces shaped as desired may be inserted with advantage. Cartilage may be inserted in any desired position into a flap

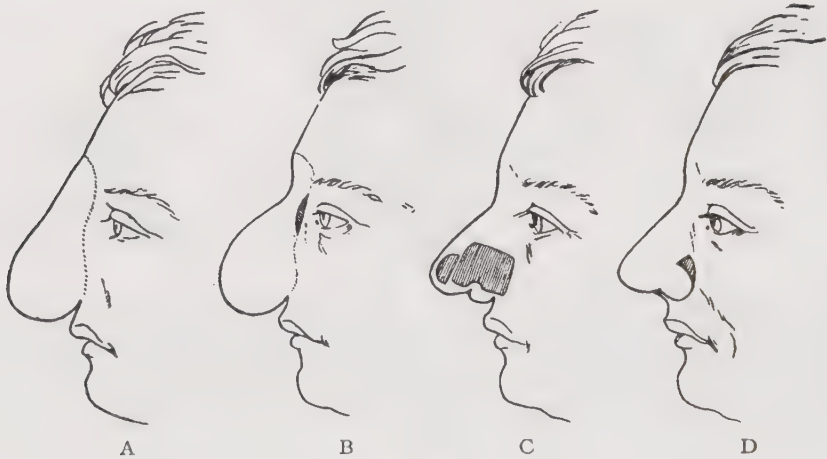


FIG. 486.

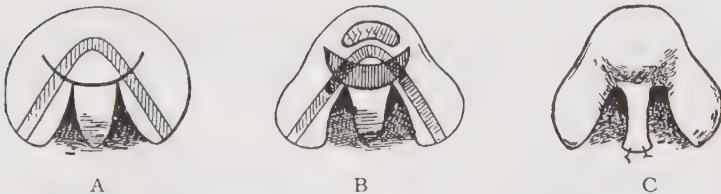


FIG. 487.

FIGS. 486 and 487.—Lexer's operation for the restoration of total loss of nose, *continued*.—After several weeks (the longer the better) the pedicle is divided and is used to fill in the defect between the brows. A number of weeks later begin the numerous shaping and rimming operations which will be necessary to bring the flap into the resemblance of a nose. To form a depression between the forehead and the nose excise the scars on each side in front of the angles of the eyes down to the bone, and remove all excessive subcutaneous tissue. If the skin is too loose after this, remove a sufficient amount from the edges so that it will fit quite snugly to the bone and suture the edges (Fig. 486B). To form the point of the nose make the semilunar incision (Fig. 487A). Raise the skin from the underlying bone with an elevator and insert a shaped piece of bone (periosteum toward the skin) between it and the skin as shown in Fig. 486C and Fig. 487B. The insertion of the bone causes the semilunar incision to gape and this is allowed to granulate. Subsequent operations are necessary for the formation of the alæ (Fig. 486D). The ultimate result is said to be good. I have never employed this method, but have cited it to give an idea of the extreme slowness with which it is sometimes necessary to proceed.

which has been folded on itself and will live, as I have demonstrated experimentally.¹

In *partial loss of the nose* the methods already described are used with modifications to meet the particular case. It must always be

¹ Davis, J. S.: Johns Hopkins Hospital Bull., April, 1913, 116.

borne in mind that the double-faced flap with the proper support is necessary for ultimate success.

I have in mind a case of luetic destruction requiring reconstruction of the lower third of the nose. Many attempts had been made to reconstruct this portion, but with little success. Finally I transplanted a piece of costal cartilage extending from the frontal bone to the lowest portion of the tip of the nose. Later, flaps were turned down from the skin on the bridge (as described in Smith's modification of Keegan's

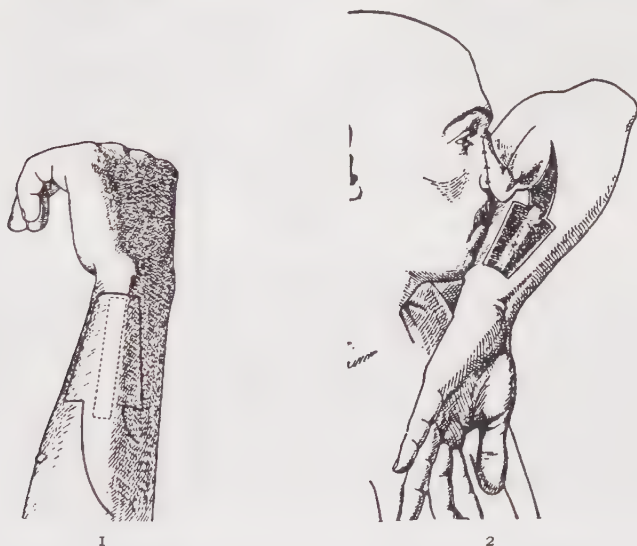


FIG. 488.—Operation for the reconstruction of the nose (*Israel*).—1 and 2. The dark lines outline the skin flap from the ulna side of the forearm. The skin is dissected up exposing the ulna, and a strip of bone 0.8 cm. \times 6. cm. ($1\frac{1}{3} \times 2\frac{1}{2}$ inches) is raised with the skin, except at the upper end where it is only partially sawed through. The skin-periosteal bone flap is bent up and protected. Nine days later the bone connection is severed. The nose is modelled as well as possible on the forearm, and the surfaces are allowed to grow together. Twelve days later the newly modelled nose is separated from adhesions on the arm, and protected from further adhesions by dressings. Five days later the margins of the nasal defect are trimmed, and the edges are turned in to line the new nose. The pedicle on the arm is lengthened and widened, and the new nose is sutured to the nasal defect.

method) to line the nose and form a septum, and a flap from the forehead was brought down over the whole, and sutured into place, care being taken to form the columna by lengthwise folding of the tip cut for this purpose.

The support given to the nose by a strip of cartilage (or bone) which impinges on the frontal bone and projects beyond the nasal bones or the "diving board" principle, is often insufficient. In order to over-



FIG. 489.—Mandry's operation for reconstruction of the nose (*Beck*).—1. A large flap with its base on the shoulder and its free end over the sternoclavicular articulation is marked out. Then the skin is dissected above and below to the sternal end of the clavicle, and a piece of bone AA', 4.5×0.5 cm. ($1\frac{1}{2} \times \frac{1}{2}$ inches) is raised with the overlying skin. A flap of skin CDD'C' is raised, its base being on the line CC', and is folded under and covers the bone on both sides with full thickness skin. The defect is closed. The flap is allowed to drop back into its bed. 2. Four days later the flap is raised throughout its length, the nasal margins are freshened and the flap is sutured in position. One week later the pedicle is severed, and the nose is shaped in due time. The criticism of the operation is that in a flap of this length the cutting of a window of skin will jeopardize the blood supply, and this will also happen if the second and third operations are performed too soon.

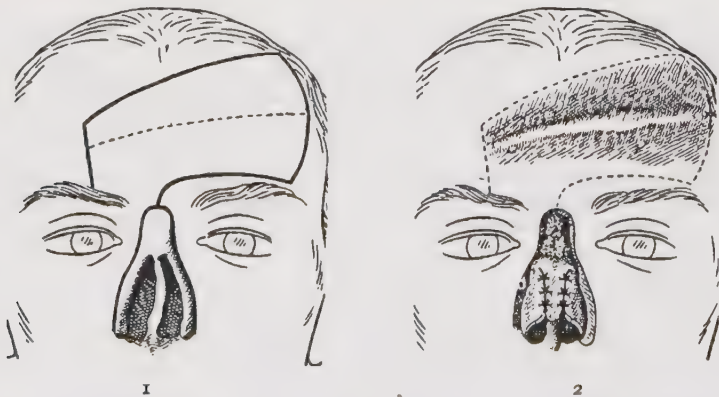


FIG. 490.—Operation for the reconstruction of the nose with cartilaginous support (modified from *Nélaton* and *Ombrédanne*).—1. Outline of incisions for the formation of the flap, and around the nose defect. The dotted line indicates the position of the implanted rib cartilage. 2. Flaps of skin around the defect are turned in and sutured together to line the nose. Note the cartilage in position under the forehead flap.

come this, it is necessary to have a support for the central piece. This may be done by double or single lateral supports, which hold the ridge in place (Aymard, and others). These may all be implanted in the flap before it is raised, or may be inserted subsequently (Fig. 492).

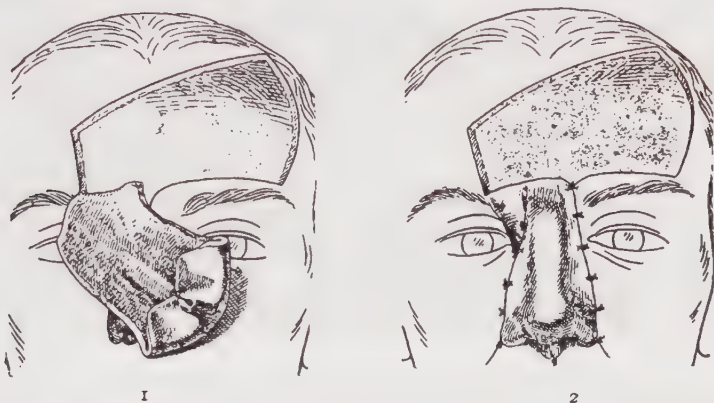


FIG. 491.—Operation for the reconstruction of the nose with cartilaginous support, *continued*.—1. The forehead flap is raised and its free end is infolded to line the alæ. 2. The flap is sutured into the nasal defect.

The columna may be incised, and the cartilage (or bone) inserted in such a way that one end rests in a hole made in the superior maxilla in the midline, and the other supports the newly formed bridge. This is, of course, possible only when there is a septum. Another method is

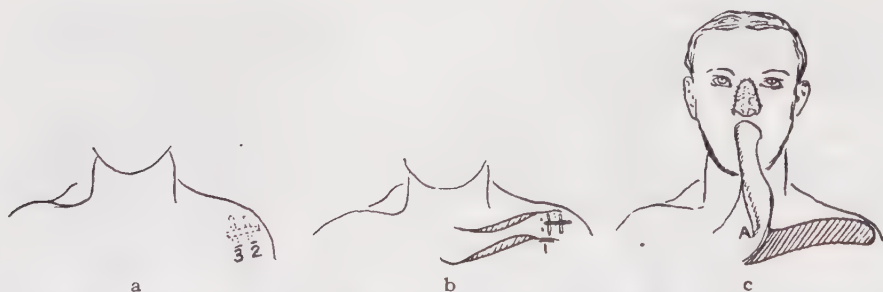


FIG. 492.—Rhinoplasty with a compound flap from the shoulder (Aymard).—a. The cartilage implanted under skin of shoulder. 1. The longitudinal piece to be the bridge. 2 and 3. The transverse pieces under 1, to act as lateral supports. b. The flap separated except at its base and extremity, infolded and sutured skin to skin. c. The flap with cartilage in position on the nose. The pedicle is cut in due time and the body of the flap is then opened and fitted into its original bed.

to implant two pieces of cartilage of sufficient length side by side in a pocket burrowed under the mucous membrane of the floor of the nose. After a sufficient interval (from four to six weeks) the muco-cartilaginous flap is raised, pedicle in front, and is folded on itself; the edges are



FIG. 493.—The restoration of a nose by the use of a pedunculated flap from the forehead.—1 and 2. Side and front views before operation. The patient had been operated on several times before coming under my care. Bone had been inserted in one of these operations and was utilized later. 3. Flaps from the skin of the nose were turned down and were folded in to line the forehead flap, and also to form the septum by the modified Keegan method suggested by Smith. The bone which had been implanted was also shifted downward. Then a pedunculated flap from the forehead was turned down and sutured into position, the columna being shaped and inserted into its proper position. The area on the forehead was grafted. Note the horsehair sutures and the tubes in the nostrils. Photograph taken five days after operation. 4. Taken four months after operation. The pedicle has been cut and several minor shaping operations have been done.



FIG. 494.—Restoration of a nose by the use of a pedunculated flap from the forehead, continued.—1 and 2. Taken three months after operation. 3 and 4. Taken six months after operation.



FIG. 495.—The restoration of a nose by the use of a flap from the forehead.—1 and 2. The tissues had been infiltrated with paraffin and treated by many methods, pedunculated flaps, etc., before admission, and the nose consisted of a flat mass of scar tissue with little or no resemblance to the normal organ. 3. A piece of cartilaginous rib was inserted in the mass of scar and healed nicely. Then the pyriform opening was trimmed out and flaps from the nose were turned down to line the forehead flap by a method similar to that described by Keegan. Then the upper portion of the nose was denuded, the flap was turned down and sutured into position, and the forehead wound was grafted. Photograph taken one week after turning down the flap. The tubes in the nostrils can be seen and also the horsehair sutures. 4. Taken five weeks after operation. The pedicle has been cut and fitted into position.



FIG. 496.—Restoration of the nose, *continued*.—1 and 2. Taken two and a half months after operation. Note the well formed columella. Several minor shaping operations were done to lower the alae. 3. Taken nine months after operation.

sutured, and the free end is attached to the under surface of the new nose.

SADDLE NOSE

Alteration in the shape of the nose depends on the extent of destruction of the bony and cartilaginous framework, consequently there are marked variations in this deformity.

Three types may be noted: (1) **Flattening of the bridge of the nose, without destruction of tissue.** This type is congenital, or follows trauma.

(2) **The loss of tissue is chiefly in the cartilage, the bones being intact,** as a consequence of injury or disease.

(3) **The cartilage and bone are both destroyed,** usually as a result of disease, sometimes of trauma.

Following severe destruction, in addition to depression of the bridge, there is a tilting up of the tip of the nose which makes the nostrils point directly forward.

The treatment depends on the amount of depression of the bridge, and the degree of tilting, the movability and normal condition of the skin, and the amount of skin contracture. If the nose is markedly tilted up and there is much scar tissue, the nasal cavity usually has to be opened in order to correct the deformity. If the tip is not markedly tilted up, and the skin is in good condition, the correction can ordinarily be made without opening into the nasal cavity.

Prosthetic injection of paraffin is often used to remedy these deformities and gives immediate results in cases in which the skin is lax. Considering the horrible complications which sometimes follow the use of paraffin in spite of its simplicity, I have never felt justified in using it.

Various inorganic materials have been implanted to raise the bridge but the same objection to burying inorganic supports holds here as elsewhere.

Numerous operations have been devised for the correction of saddle nose, but I will only mention those which I have found useful, and one or the other of which may be employed in the correction of cases ordinarily seen.

Cartilage Implantation for Raising the Bridge

The method which has given me the greatest satisfaction is that originated by von Mangold. The insertion of a piece of rib cartilage

to form the new bridge can either be done externally through an incision between the eyebrows, or across the bridge of the nose, or internally along the muco-cutaneous margin, just inside the nostril. The latter incision avoids an external scar, but I prefer not to take the greatly increased chance of infection which the internal incision gives. The external scar can be made very inconspicuous and the greater safety of the external incision (in addition to the better control of the transplant), makes its use desirable.



FIG. 497.—Saddle nose due to trauma. Duration two years.—1. Before operation. 2. Two years after the implantation of a free graft of cartilaginous rib. No shrinkage has occurred.

My method of procedure probably differs little from that of many others. A short transverse, or slightly curved incision, is made at the root of the nose, with its convexity toward the tip, and the soft parts are divided down to the periosteum. A silk suture is placed in each lip of the wound for retraction. The periosteum is incised transversely and is undermined in the midline until the nasofrontal junction is reached. With a pair of Mayo scissors a tunnel is made between the skin and mucous membrane, from the transverse incision to the tip of the nose (or so far as it is desired to have the graft extend) care being taken not to open into the nasal cavity. Lateral adhesions should be divided subcutaneously through the same incision, and the nose loosened so that the tip may be lowered. Measurement is then taken of the maximum length of cartilage required, and pressure is applied to control bleeding. The cartilage is secured from the cartilaginous rib

as has been previously described (fresh gloves and instruments being used) and the wound is closed, care having been taken to check the hemorrhage and to eliminate all dead spaces. The cartilage to be inserted must be shaped to fill out the depression that it is meant to correct, and this can be done by means of a pattern, or by freehand trimming after several trials at placing it in position. As there is a tendency for the cartilage to bend somewhat when it is cut, this must be taken into consideration, and a straight piece be used, otherwise although the bridge may be raised, the tip of the nose may be deflected.

to one side or the other. I usually endeavor to retain the perichondrium on one side of the transplant and try to place this side under the skin if it is convenient to do so. Nevertheless, I have had good results when



FIG. 498.—Saddle nose, probably due to congenital lues.—1 and 2. Before the implantation of a free cartilaginous graft. 3 and 4. Three months after operation. By massage the tip of the nose is being gradually lowered and the adjacent skin stretched during the eighteen months since operation, so that with further minor operative procedures a good result will be obtained. In a case of this type opening into the nasal cavity is often necessary in order to lower the tip of the nose.



FIG. 499.—Saddle nose due to lues. Duration several years.—1 and 2. Front and profile view before operation. 3 and 4. Front and profile view two weeks after the implantation of a free graft of cartilaginous rib. Note the position of the scar and the improvement in appearance. 5. The result nineteen months after operation.

the perichondrium is away from the skin, as well as with the cartilage completely stripped.

When the tip of the nose does not need depressing, the cartilage is simply placed in the channel prepared for it. The cartilage may

be left quite thick at the point of greatest depression, or it may be reinforced by shorter pieces secured beneath it.

When we desire to depress the end of the nose, the tunnel having been made to the tip, the cartilage is bent and is sprung into the channel prepared for it, impinging against the frontal bone and extending to the tip of the nose. It is secured from lateral slipping with two or three sutures of fine catgut, and the skin is closed with on-end mattress sutures of horsehair.



FIG. 500.—Saddle nose following lues. (Surg. No. 44327). 1 and 2. The remaining portion of the nose is retracted almost to the level with the cheeks. Note the scant amount of skin, and also the length and prominence of the lip. The white spot in the center of the floor of the nose is a misplaced normal tooth. 3, 4 and 5. The appearance of the nose after the implantation of a piece of cartilage to bring out the bridge, and also pieces to hold on the alæ. Infection occurred on the left side of the nose and a portion of the cartilage supporting the alæ on that side was lost. The septum was formed from flaps taken from the upper lip by the method shown in Fig. 529.

A cast made of one of the flexible paraffin mixtures and replaced every 24 hours during the first week, is an excellent dressing, and minimizes the scar.

I have used free cartilage transplants in a number of instances and find them most satisfactory. Sometimes the spring of the cartilage causes the skin on the tip of the nose to become thin at the point of pressure, but this area may be removed and the cartilage shortened slightly, without interfering with the result (Fig. 497-500).

Where the skin is contracted the tension may be relieved by making an inverted V-shaped incision, the point of which is just above the cartilage, and then pushing the skin down and suturing it in the shape of a Y.

Instead of using a single piece of cartilage, one may be inserted on each side. Again, pieces may be inserted to support the alæ through small incisions in the naso-labial fold on each side of the nose. It is very difficult to tunnel along the ala without perforating either the skin or the mucous membrane.

Free bone (from tibia, ribs, and elsewhere, Israel, Depage, and others) has been used to fill out the depression in saddle nose (either in a single piece or split and folded like a roof) in much the same manner as just described for cartilage, but in my experience bone is not so satisfactory. Rib bone with its adjacent cartilage has been used, the bone to form contact with the nasal bone, and the cartilage to extend beyond, but I can see no advantage in this over the entire cartilage graft. It is probably the first step on the part of those operators who previously vigorously defended the use of bone as against cartilage, to change to cartilage, as they surely will when they become more familiar with its use.

In the severe cases in which the nasal cavity has to be opened in order to depress the tip of the nose, the opening should be closed with a flap having its skin surface inside, the tip held in the desired position by means of some rigid material, and the surface defect closed. To effect this several operations have been devised. I shall consider only those whose principles are correct; they may be modified or combined to suit the individual case.

Cheyne and Burghard's Operation for the Correction of Marked Saddle Nose.—A vertical incision is made in the midline from the root of the nose downward as far as necessary. Transverse incisions are carried across both ends of the vertical incision and flaps are laid back. The cartilage is then separated from the bone by a transverse incision which opens into the nasal cavity, and the tip of the nose is pulled down into normal position. An incision starting about 1.25 cm. ($\frac{1}{2}$ inch) above the root of the nose, and 0.312 cm. ($\frac{1}{8}$ inch) from the midline is carried vertically upward to the hairline. Then another parallel incision is made 0.312 cm. ($\frac{1}{8}$ inch) on the other side of the midline. A transverse cut connects these incisions above. The tissues are divided down to the bone. This marks out a flap 0.625 cm. ($\frac{1}{4}$ inch) wide with its base near the root of the nose. Then with a chisel the superficial portion of the outer table of the bone is raised with the flap, the bone is broken across at the base and the flap is turned down. The flap consists of a narrow strip of skin with a thin layer of the frontal bone, and should be long enough to reach the cartilaginous edge of the

gap in the nose when the tip is in its normal position. The epithelial surface of the flap above the opening into the nose is denuded, and the end is then stitched to the cartilaginous portion, so that its skin surface covers the opening into the nose. The lateral skin flaps are loosened and closed over the raw surface of the bone flap in the midline and the wound on the forehead is sutured. Three weeks later the pedicle of the reflected flap is severed, and the parts adjusted.

The authors admit that there is usually sinking of the bridge when the operation is performed as above described, so that secondary implantation of bone or cartilage becomes necessary (Fig. 501).

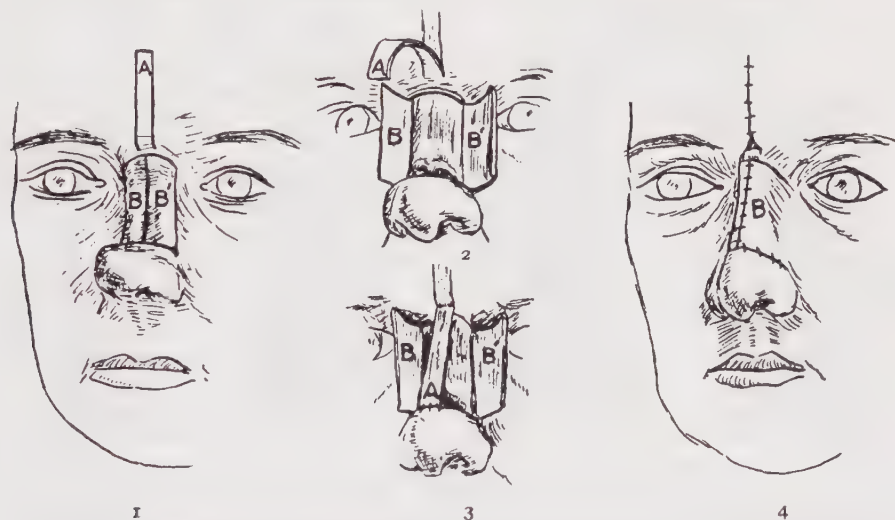


FIG. 501.—Operation for saddle nose (*Cheyne and Burghard*).—1. Lines of incision: A, the skin, periosteum and bone flap from the forehead. This flap extends to the hair line. BB' the lateral flaps. 2. The forehead flap A and the lateral flaps BB' reflected. The tip of the nose pushed down. Note opening into the nose cavity just above tip. 3. The frontal flap turned down and sutured. 4. The lateral flaps are shifted in and sutured over the frontal flap.

My criticism of the method is that the frontal flap is too narrow throughout and that consequently its blood supply is doubtful. With a broader, more flaring pedicle, and a wider, thicker flap, the result would be better.

Nélaton and Ombrédanne's Operation.—Through a small incision in the hairline a tunnel is burrowed between the periosteum and the bone and a piece of costal cartilage about 5 cm. (2 inches) long is inserted vertically and exactly in the midline. Six weeks later an inverted U-shaped incision is made, the middle of which extends as far above the eyebrows as it is desired, to depress the tip of the nose. The arms

the U spread somewhat at the inner ends of the eyebrows, extend downward as far apart as the eyes will permit, and then along the fold between the nose and the cheeks, to points just above the alæ. The flap is dissected free and folded down, and at a point about 1.5 cm. ($\frac{3}{8}$ inch) above the tip of the nose a transverse incision is made into the nose, so that the tip may be brought down into normal position. This will bring down the free end of the flap to the level of the eyebrows. The second flap containing the cartilage is then raised, as shown in the diagram, care being taken to preserve its blood supply. The entire periosteum under the flap may be raised with it, but my preference

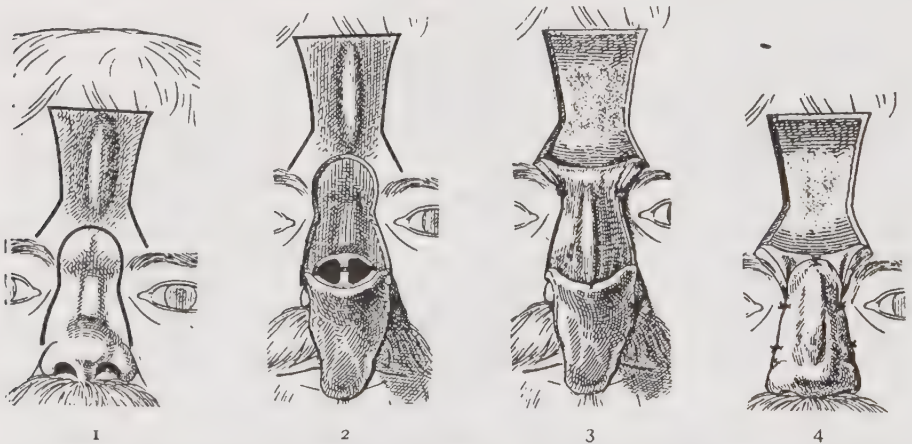


FIG. 502.—Operation for marked saddle nose (modified from *Nélaton and Ombrédanne*). 1. Shows incisions to be made in formation of flaps. Note cartilage graft already implanted in center of forehead flap. 2. The nose flap dissected up, and the tip of the nose lowered by transverse incision. 3. The forehead flap turned down, and sutured. 4. The nasal flaps replaced, so as to cover the raw surface of the frontal flap.

s to save as much as possible, and to remove only that in the immediate neighborhood of the cartilage. The freed flap should then be turned down so that its upper edge just meets the lower edge of the gap in the lowered tip of the nose. The cutaneous surface is in this way inward and the tip is held in position by the cartilage. The epithelium should be removed from all points where it does not line the opened nasal cavity, and the edges are then sutured into the defect. The first flap is drawn up over that reflected from the forehead and is sutured. The gap in the forehead is either grafted immediately, or after the pedicle has been cut. Fifteen days later the pedicle of the frontal flap is cut, and the edges are fitted in (Fig. 502).

This is an excellent operation. The use of cartilage is preferable to bone in these cases for purposes of support. A combination of

this method of using cartilage with the lateral flaps in Cheyne and Burghard's operation might be of use in certain instances in which the skin is lax.

Care must be taken in operations of this type to remove all epithelium from the under surface of the flap which is not used for lining the nasal cavity.

J. B. Roberts' Operation for Saddle Nose.—A deep incision is made across the transverse groove in the sunken region. This open-



FIG. 503.—Operation for saddle nose (*Roberts*).—1. Outline of incisions for raising cheek flaps. 2. The flaps turned, skin surface inward, to line the nasal defect. The pedicles are severed subsequently.

into the nasal cavity and allows the tip of the nose to be pulled down. A flap whose width corresponds to the breadth of the gap is raised from each cheek near the naso-labial fold. They are folded over into the gap, epithelial surface inward, and the ends are sutured in the midline. A few sutures should also be applied along the edges. The areas from which the flaps were raised may be sutured at once. The raw surface of the folded over flaps may be allowed to cicatrize, or better still ma-



FIG. 504.—Operation for saddle nose, *continued*.—1. The outline of flaps to cover the freshened surface of the lateral flaps, either after healing, or when they are granulating. 2. The flaps shifted downward into position.

be immediately grafted. After healing is complete, the pedicles are cut and fitted into position.

In order to thicken the flaps, and at the same time to improve the appearance of the nose, the following procedure is then carried out. An inverted V-shaped incision is made, having its apex in the middle of the forehead, and its legs running downward to points just below the inner canthi. Just above the granulating or healed surface a simil-

incision is made, and the apices of these V-shaped cuts are joined by a vertical incision. This marks out two rhomboidal flaps, with their pedicles on the cheeks close to the nose. The flaps are dissected up on each side and shifted down over the prepared area, so that one lies directly above the other. The tip of each is sutured to the pedicle of the other (Fig. 503-504).

This is a good operation in selected cases, but does not have the advantage of a rigid support.

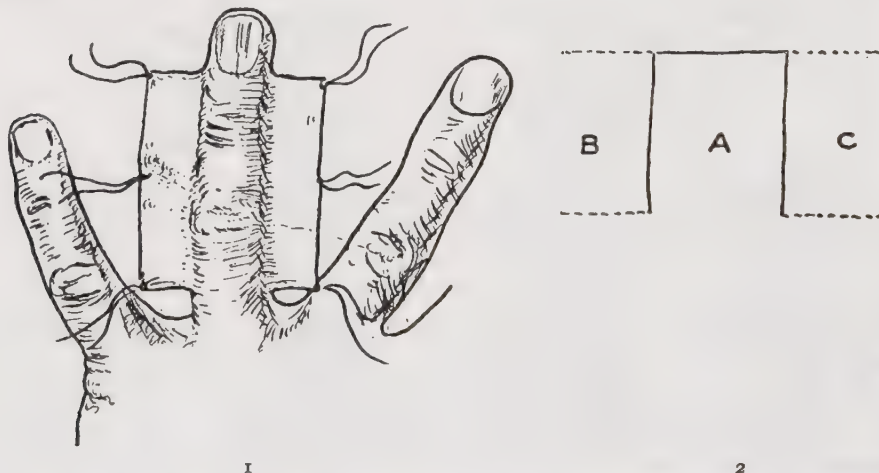


FIG. 505.—Method of lining the finger flap when the finger is used in rhinoplastic operations (*Baldwin*).—1. The left ring finger is split in the midline on the palmar surface, and transverse incisions are made at the level of the nail and of the web. The tissues are turned back and the flexor tendons are removed. 2. A pedunculated flap is raised from the lower abdominal wall on the right side; the skin on the areas B and C being undercut and closed beneath it. Then the flap is applied to the raw surface of the finger and in due time the pedicle is cut. Contracture is prevented by attaching the ends of the marginal sutures to a metal plate of the desired size.

In cases due to severe trauma, the depressed nasal bone may be freed and raised to reform the bridge. This should be done through a skin incision. A septal flap with pedicle above or below may also be used to fill out the defect in saddle nose.

The Use of the Finger in Rhinoplasty.—The finger has been successfully used in reconstructing a new nose, or for supporting a collapsed nose on several occasions (*Hardie*, 1875, *Vredena*, *Finney*, *Watts*, *Baldwin*, *McWilliams*, *Ludington*, and others), and also for the formation of the framework in severe cases of saddle nose.

I have noted that a surgeon seldom reports more than one case operated on by this method. This may be due to the fact that only one patient requiring this kind of operation has come under his care,

but my feeling is that it is unnecessary to lose a finger, when better results can be obtained by other methods.

In the finger operations, as well as in all others in which reconstruction of the nose is desired, a lining must be provided for the nose, and this may be simply and effectually accomplished by Baldwin's method, which is well explained in the diagrams (Fig. 505). The fourth toe has been used by double transfer, to hand, to nose (Kausch), but this method seems unnecessarily irksome.

RESTORATION OF THE LOWER PART OF THE NOSE

In reconstructing the lower portion of the nose the Italian method is found to give the best results with minimum scarring. If the nostrils are destroyed only at the anterior portion, a single flap may be

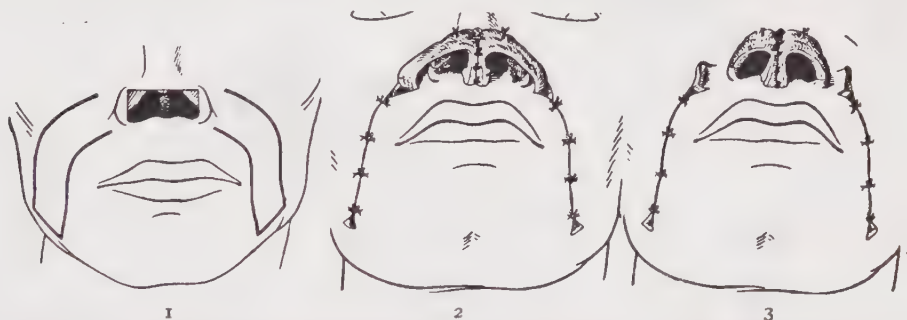


FIG. 506.—Operation for restoration of the lower portion of the nose (*Bayer-Payr*).—1. Outline of cheek flaps. 2. Flaps turned over and sutured in position. Note method of formation of columna. 3. Pedicles cut and sutured to stumps of alae. The surface may be either grafted or covered with an arm flap.

sufficient, but when the nostrils are completely or almost completely destroyed, an external and an internal flap must be provided, in order to prevent contracture. When the destruction is not very extensive the internal flap may be formed from the skin of the nose itself, but when the destruction is great, both layers must be formed from tissue obtained elsewhere.

Numerous operations have been devised for reconstruction of the lower part of the nose, but only two will be considered.

The Bayer-Payr Operation.—A curved flap with its base just beyond the ala, and extending downward outside the angles of the mouth is raised on each side. The width of the flap should correspond to the height to be added to the tip of the nose; the length should be sufficient to allow the formation of the alæ and columna. The flaps are folded



FIG. 507.



FIG. 508.

Operations for the reconstruction of the lower part of the nose (modified from *Nélaton* and *Ombriédanne*).

FIG. 507.—The use of a flap from the forearm with its pedicle at the wrist.

FIG. 508.—1. Outline of a flap from the arm with its pedicle toward the elbow. The dotted line indicates the final shape of the flap. 2. The arm in position and the flap sutured to the nose.

over, the ends are turned in (raw surface to raw surface) and sutured to form a columna. The edges are then sutured to the freshened edges of the nose defect and the cheek wounds are closed. After three weeks the pedicles are cut, turned in and attached to the stumps of the alæ. The raw surface of these flaps may be grafted or covered with a flap from the arm (Fig. 506).

This is an excellent operation, and when used in connection with the arm flap is the method of choice in severe cases.

Nélaton and Ombrédanne's Operation Where There is Destruction of the Anterior Segment of the Nostrils.—The edges of the defect are freshened, all adhesions are divided, and a flap from the anterior portion of the forearm, with its base toward the wrist is raised and sutured into



FIG. 509.—Operation for the reconstruction of the lower part of the nose, *continue* (modified from Nélaton and Ombrédanne).—1. The pedicle has been cut after the flap shown in Figs. 507, 508, 2 has been transplanted. The free end of the flap is trimmed in some such manner as is shown by the dotted lines in Fig. 508, 1. The columna may be formed by infolding the pedicle end of the flap, or by cheek flaps as indicated by the dark lines, which may be turned up before the arm flap is transplanted. 2. The columna and alæ have been formed from cheek flaps by the Bayer-Payr method, and then the raw surface covered by a flap from a distant part.

the defect. Ten to fourteen days later the pedicle is cut. Several weeks later the columna is formed and inserted into the upper lip, and the edges are trimmed and shaped (Fig. 507-509).

Where the nostrils are completely destroyed two methods may be employed, both of which depend on the formation of an internal and an external skin surface in the construction of the nostril. The Bayer operation is performed, and then a pedunculated flap from the arm is used to cover it. The other method is to shape the flap from the arm in such a manner that the edges may be turned under to line the nostril with skin and form the columna, after the pedicle has been severed.

RESTORATION OF THE ALÆ

Practically all of the methods used in plastic surgery have been employed in the various operations described for the restoration of the

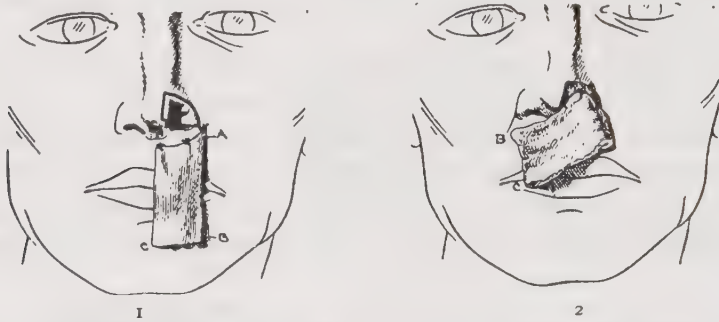


FIG. 510.—Operation for the restoration of the ala (modified from Nélaton and Ombrédanne).—1. The flap ABC, from the forearm, is inserted in a curved incision just below the nostril, skin surface outward, and the pedicle is severed two weeks later. 2. The edges of the nose defect are freshened. The flap is twisted and rolled so that skin surface is inward, and is sutured to the inner margin of the defect.

alæ. The type of operation to be selected depends largely on the amount of destruction, and the operation best suited to each case should be carefully considered. If the entire ala is destroyed, the problem is much more complicated than when a stump is left on which to fasten the newly formed ala.

Flaps from the forehead have been used by Dieffenbach, Labat, Szymanowski, and others, but the same objection (that of implanting a single unlined flap) obtains here as in the more extensive operations. There is also the great disadvantage of extensive scarring, which may be more disfiguring than the defect to be repaired. This method is not to be advised except in the treatment of somewhat extensive defects, and then only after preliminary lining of the end of the flap.

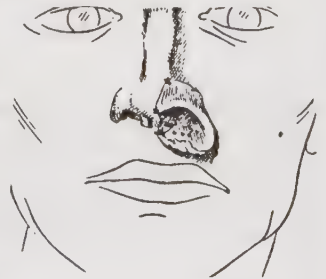


FIG. 511.—Operation for the restoration of the ala, continued.—The free end of the flap is turned back on itself, covering the raw surface, and forms the nostril with skin inside and outside.

The Italian method may also be used with advantage as follows: Raise a flap from the forearm and fold the free end on itself, after including a thin, shaped plate of rib cartilage. Then, after healing is complete, freshen the edges of the defect, split the folded margin of the flap, raise the arm, and suture it to the nose. After ten days or two weeks cut the pedicle, and later trim the edges and shape the ala.

Nélaton and Ombrédanne have used an arm flap in the following manner: A long, fairly narrow flap of skin and subcutaneous fat is raised from the middle third of the forearm, and the extremity is sutured (the skin surface exposed) into an oblique incision extending downward and inward from the naso-labial fold, outside the destroyed ala, to a point below the septum. Two weeks later the pedicle is cut, the nostril defect and the external border of the flap are freshened, and the flap is twisted and folded so that its skin surface is inward. In this position it is sutured to the mucous edge of the defect. The flap is then folded back on itself, raw surface to raw surface, and sutured so that there is skin on both sides, and what was originally the inner edge of the flap is now the inferior border. There is a considerable amount of excess tissue which can be trimmed subsequently (Fig. 510-511).

This method does not seem as useful as that which I have described just above, and is much more complicated.

The French Method

The majority of operations devised for restoration of the ala have called for the use of sliding flaps. If the defect is of any size, single unlined flaps are contraindicated. The use of a flap including the full thickness of the lip (Blandin) is not advisable.

In some small defects, flaps may be turned down from the nose itself to line the cavity. Michon has devised an operation for lining the skin flap with mucous membrane flaps from the septum; and Thompson has used a muco-cartilaginous flap from the septum for the same purpose, but both methods are unsatisfactory. Flaps through the full thickness of the nose, including the rim of the defect have been shifted down to form the margin of the ala, and the defect above has been filled with flaps from elsewhere.

Denonvilliers' Operation for Restoration of the Ala.—Denonvilliers restored the ala by sliding downward over the defect a pedunculated flap of skin from the side of the nose (Fig. 512). The pedicle may lie anteriorly near the tip of the nose, or toward the cheek (Tillaux). The defect left by shifting the skin down may be grafted or allowed to granulate (Fig. 513).

Mütter's Operation.—The edges of the defect are freshened by a ∇ inverted V incision, and from the end of the outer arm of the V a horizontal incision is made outward on the cheek. The skin is undermined, the entire flap is shifted toward the midline across the defect and

sutured. In this operation there is no attempt at forming a normal looking ala, but the appearance may be improved by subsequent operations (Fig. 514).

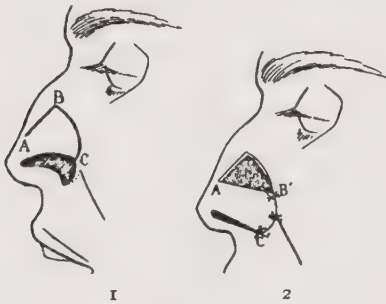


FIG. 512.

FIG. 512.—Denonvilliers' operation for the reconstruction of the ala (*Duvernoy*).—1 and 2. The flaps of skin ABC, with pedicle on the nose near the midline, or on the cheek, are raised, and shifted downward to cover the ala defect.

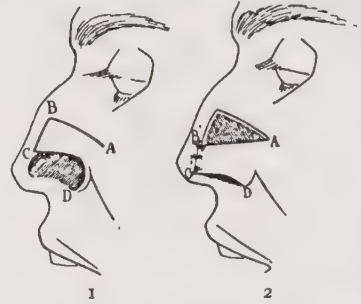


FIG. 513.

FIG. 513.—Tillaux's operation for the reconstruction of the ala (*Duvernoy*).—1 and 2. This operation differs from that of Denonvilliers' only in that the pedicle of the flap ABC is on the cheek.

Sédillot's Operation.—A quadrilateral flap is marked out with its base at the point where the cheek should meet the absent ala, outside of and below it. The upper incision should enter the nostril; the end of the lower incision should be far enough away not to interfere with the

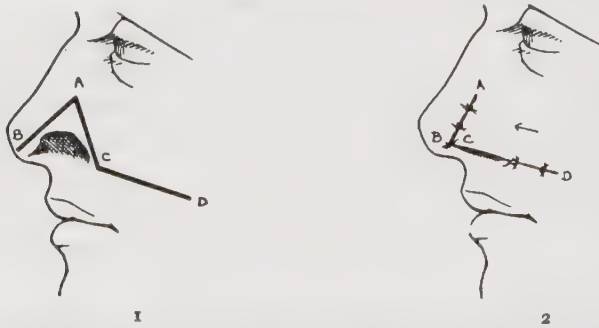


FIG. 514.—Operation for the restoration of the ala (*Müller*).—1. The margin of the defect is excised (or turned down) by the incision BAC. The horizontal incision CD is then made, and the cheek flap is undermined. 2. The cheek flap is shifted toward the midline, the point B and C being approximated.

blood supply. It should be long enough, when raised, to be sutured without tension, and wide enough to fill the gap. The pedicle is twisted so that the curl of the ala is reproduced and the skin surface is outside (Fig. 515).

Several other operations of this type have been done with different shaped flaps.

A. Nélaton's Operation.—A quadrilateral flap, with its pedicle above, is raised from the fold between the nose and the cheek. When the outer part of the ala is intact it will be necessary to excise a small triangular area of skin above the defect. The flap is then shifted in across the skin that remains on the side of the nose, and sutured over the defect. The

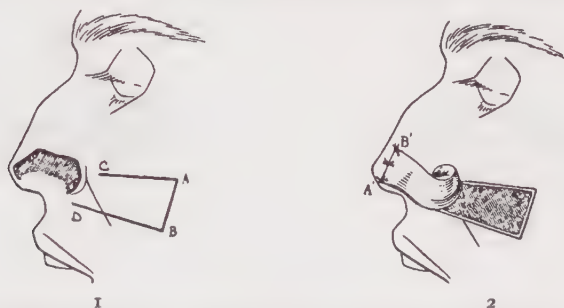


FIG. 515.—Sédillot's operation for the restoration of the ala (*Duvernoy*).—1. The flap CABB, with its pedicle near the nose, is outlined and raised. 2. It is twisted so that the skin surface is outward, and the pedicle forms the curl of the ala.

small triangular area may, at times, be turned down with its pedicle at the margin, to act as a partial lining for the cheek flap. The cheek defect is sutured, if possible; otherwise it is grafted (Fig. 516).

Preidlsberger's Operation.—A rectangular flap 2. \times 3. cm. $\frac{4}{5} \times 1\frac{1}{5}$ inches) with its base close to the defect, is raised from the cheek and



FIG. 516.—A. Nélaton's operation for the restoration of the ala (*Duvernoy*).—1. The flap D, with its pedicle upward, is raised. The triangle of skin C is either excised, or turned down to line the flap D, which is jumped over the area E. 2. Shows the flap in position. The shaded area may be grafted.

turned backward with the skin surface inward. It is sutured to the freshened edges of the defect. The area from which it has been raised is sutured, and the raw surface of the flap is grafted with Ollier-Thiersch grafts (Fig. 517).

For all of these operations just described for the restoration of the

ala the operators have used sliding flaps of single thickness skin. This means that in all cases, except those which are small, there will be contracture and subsequent deformity. None of these operations are to be recommended if done as they were originally described, but *there are possibilities in each one of these procedures if the flap can be*

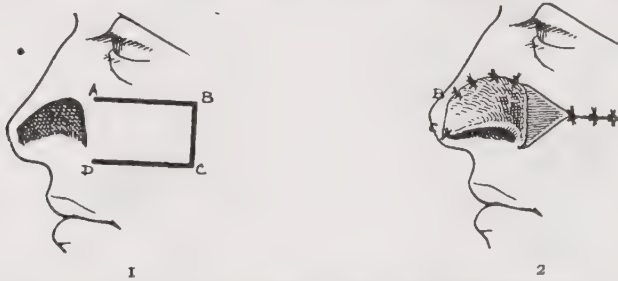


FIG. 517.—Operation for the restoration of the ala (*Preidlsberger*).—1. Outline of incision to raise the flap ABCD, with base adjacent to the defect. 2. The flap raised, turned over, and sutured into the freshened margins. The raw surfaces may be grafted.

lined with epithelium before being shifted. This can easily be done by the buried method and in addition a bit of cartilage may be inserted in cases requiring stiffening before the flap is shifted. In many instances marginal flaps may be turned down to serve as a lining.



FIG. 518.—Operation for the restoration of the ala (*Bouisson*).—1. The flap A with pedicle adjacent to the nasal defect is raised, turned over (skin surface inward), and sutured to the margin of the defect. 2. The flap B, with its pedicle on the cheek, is raised and shifted toward the midline, and sutured, thus covering the raw surface.

Ala defects have been restored by the use of double flaps (*Bouisson*), one with its skin surface turned in, the pedicle being close to the margin of the defect (somewhat after the method of *Preidlsberger*), and the other flap, with its base away from the defect, being shifted in to cover it. I mention this method merely for the idea suggested by it. As a matter of fact the procedure has little to recommend it, and to a large extent has been abandoned.

Bouisson has also proposed a similar method in which he lowers

a flap of the cartilaginous edge of the defect to form the edge of the ala and then shifts in a covering flap from the cheek (Fig. 518-519).

Von Hacker's Operation for the Restoration of the Ala.—A flap with its base toward the cheek, cut from the entire thickness of the nose, is shifted down and sutured to fill the ala defect. The opening



FIG. 519.—Operation for the restoration of the ala, utilizing a rim of nasal cartilage (*Bouisson*).—1. The flap A, consists of the skin and cartilage edge of the defect. It is shifted down, turned raw surface outward, and is sutured in place. 2. The flap B from the cheek is shifted in to cover this.

left above by the lowering of this flap is filled with a pedunculated flap from the cheek, having its base toward the nose. This is turned over into the defect and sutured, skin inward. The surface of the flap may be grafted at once or later, or it may be lined before the flap is transplanted. The pedicle is severed and fitted into position after ten

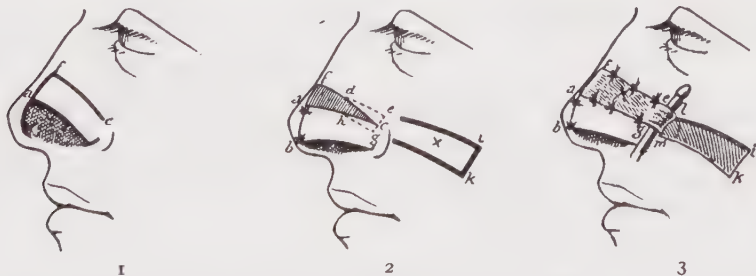


FIG. 520.—Operation for the restoration of the ala (*v. Hacker*).—1. The flap *ac* is cut through the entire thickness of the nose, and is shifted downward to form the new ala. 2. The flap *X* with its pedicle adjacent to the nose is then raised. The triangles *dce*, and *hgc*, are excised, and the flap *X* is turned over and sutured in to the defect, skin surface inward. 3. The flap in position. The raw surface is grafted. The pedicle is cut after 10 to 14 days.

days or two weeks. The wound from which the flap is raised is either sutured or grafted (Fig. 520).

Kredel used a triangle of cartilage from the ear, and F. König transplanted a section of the full thickness of the margin of the ear into defects in the ala. Joseph used a transplant of the full thickness of

one ala, to fill that in the other. I have not used these methods, and see no reason to mutilate the ear or other ala, when cartilage is so easily obtainable elsewhere (Fig. 521-522).

The anterior portion of the inferior turbinate has been advanced to form the lining and support of a newly constructed ala. It is divided as far back as is necessary, is loosened, swung forward with the pedicle in front, and attached to the septum. After healing has taken place the mucous membrane is removed from the outer surface and a skin flap is turned in from the cheek to cover it. Later the necessary shaping operations may be done. This gives a rigid ala (Hett).

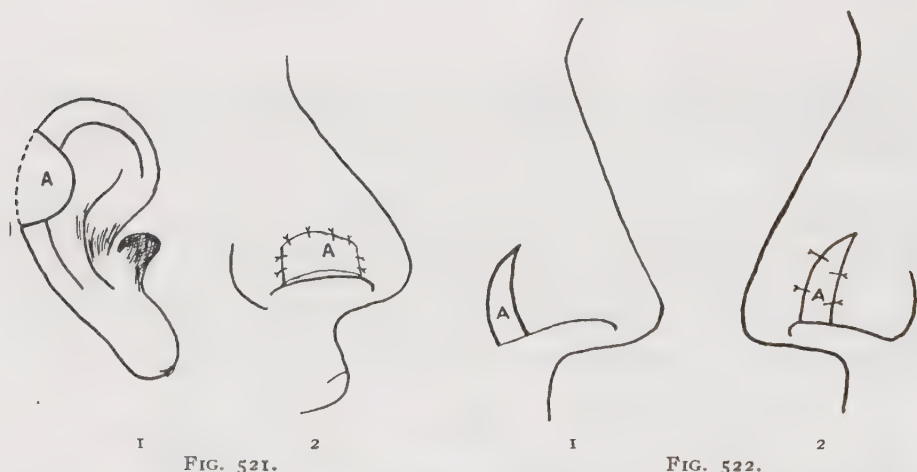


FIG. 521.

FIG. 522.

FIG. 521.—Operation for the restoration of the ala (*F. König*).—The edges of the defect are freshened, and a section of the same size from the full thickness of the ear is removed and transplanted. The ear defect is closed by a plastic operation.

FIG. 522.—Operation for closing a defect in one ala, by means of a free flap from the ear (*J. Joseph*).—1. The outline of the incision through the full thickness of the nose. 2. The graft sutured into the defect in the other ala.

Restoration of the Tip of the Nose

At times we are called upon to reconstruct the tip of the nose. If the destruction is of the soft parts only the cartilage being intact, we may graft the defect or apply a thin flap from the arm. If the soft parts together with the anterior extremity of the cartilage, have been destroyed, the Indian and French methods should not be tried, on account of the liability of causing a deformity more unsightly than the original defect.

The Italian method, on the other hand, is most satisfactory for these cases and can be used without scarring the face. If cartilage is

needed to support the tip it may be implanted in the flap before bringing it to the nose, or inserted subsequently. The same methods may be employed as have already been described for the restoration of the lower part of the nose.

THE RESTORATION OF THE LOWER PART OF THE SEPTUM (COLUMNA)

The absence of the lower part of the septum may be extremely disfiguring. The French method is that usually employed for the restoration of the columna, and a number of operations have been devised. The Indian method causes unnecessary scarring, and should not be used, but the Italian method may be used with advantage in certain cases.



FIG. 523.—Operation for the restoration of the columna (*Labat*).—The flap is raised from the web between the thumb and fingers, and the hand is held in the position shown. Two weeks later the pedicle is cut.

Where there is no deformity of the nostrils and the tip of the nose has not collapsed, any of the simple methods of utilizing tissue from the lip will be sufficient. If the nasal orifice is distorted, and the edges are infiltrated with scar tissue and are depressed, one must resort to some method in which a support is employed. Where the nostrils are retracted and drawn in, one of the plans used for the restoration of the lower part of the nose is applicable.

Labat's Operation for Restoration of the Columna.—A flap of suitable size is raised from the web of the thumb and is attached to the tip of the nose, skin surface outward. The palm of the hand is forward, the thumb on one side of the nose and the fingers on the other. Ten days later the pedicle is cut and the end is attached to the root of the lip. This type of operation may be of great use, and if the flap is prepared in advance by being turned on itself, or if its raw surface be grafted and a piece of cartilage also implanted, this method has all the advantages and none of the disadvantages of the other methods (Fig. 523).

Dupuytren's Operation.—A flap of sufficient width is raised from the upper lip down to, but not including, the mucous membrane. The base of the flap is at the root of the septum and the tip is at the vermilion border. It is then twisted so that the skin surface is exposed, and the free end is sutured into the tip of the nose. The lip wound is then closed. This operation can be much improved by buried grafting of the under surface of the flap, which will allow less subsequent contracture (Fig. 524).

Serre's Operation.—This operation is the same as that of Dupuytren except that the base of the flap is at the vermilion border. The flap is raised and attached to the tip of the nose; later the pedicle is

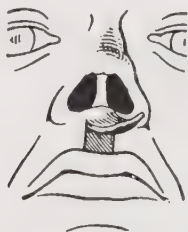


FIG. 524.



FIG. 525.

FIG. 524.—Dupuytren's operation for the restoration of the columna (*Duvernoy*).—A rectangular flap is raised from the midline of the upper lip, its base at the root of the septum. The flap includes the full thickness of the lip, except the mucous membrane. It is turned up and twisted to bring skin surface outward, and is attached to the tip of the nose. The lip defect is sutured.

FIG. 525.—Serre's operation for the restoration of the columna (*Duvernoy*).—A flap is raised from the midline of the skin of the lip, its base being at the vermilion border. The free end is then attached to the tip of the nose. Its pedicle is cut 10 days later, and the base is attached to the upper lip.

cut and the base is inserted into its proper place. This operation can also be improved by buried grafting of the flap before it is raised (Fig. 525).

These operations which aim to form the septum from the full thickness of the lip are not desirable, because the mucous membrane is on the exposed surface of the columna and damage is done to the lip.

Lexer's Operation.—A flap of mucous membrane and the submucous tissue is raised from the midline of the under surface of the upper lip, with its pedicle at the base of the septum. A short horizontal incision is made through the lip at the point where the lip and septum meet. After the flap has been folded lengthwise and sutured, raw surface to raw surface, it is pulled through this incision and is secured to the tip of the nose. The defect in the mucous membrane is closed at once (Fig. 526).

This operation, although simpler, has the disadvantage of exposing mucous membrane, and I have never yet seen lip mucosa assume the appearance of the skin.

Szymanowski's Operation.—A flap is raised from the skin of the nose. Its pedicle on one side extends to the nostril, and on the other



FIG. 526.—Operation for restoration of the columella (*Lexer*).—1. The flap raised from the midline of the under surface of the upper lip with pedicle above. Note freshening of tissue in narrow transverse area C, at the base of the flap. 2. The notch D, on under surface of the nose is to receive the tip of the flap. The transverse black line indicates the position of the incision through the lip, which opens behind the base of the flap. 3. The flap folded on itself and sutured lengthwise. Sutures are placed to close the defect in the mucosa. 4. The flap brought forward through the incision in the lip and sutured to the tip of the nose.

curves outward well above it to insure its circulation. The flap is then shifted downward and its free end is attached to the upper lip. The defect on the nose is either sutured or grafted. This operation is not to be recommended, but is mentioned to show the type in which a flap from the skin of the nose is used (Fig. 527).

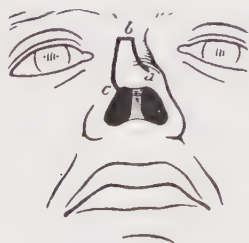


FIG. 527.

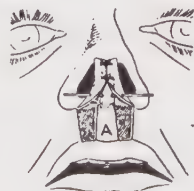


FIG. 528.

FIG. 527.—Operation for the restoration of the columella (*Szymanowski*).—The flap abc, from the skin of the nose is shifted downward, the line b, being attached to the upper lip.

FIG. 528.—Demons' operation for the restoration of the columella (*Duvernoy*).—Two flaps are raised from the skin and subcutaneous tissue below each nostril. The base is at the nostril and the free ends at the vermilion border. The area A, in the midline is undisturbed. The flaps are raised, rotated inward, and sutured raw surface to raw surface. The free end of the double flap is then sutured to the tip of the nose.

Demons' Operation.—Two rectangular flaps of skin and subcutaneous tissue are raised from below each nostril. The pedicles are above and the free ends reach to the vermilion border. The flaps are separated by the skin in the middle portion of the lip. The

are turned up and folded so that the raw surfaces are apposed, and the edges are sutured. Then the end of the double flap is attached to the tip of the nose and the lip wounds are closed. After healing, it may be possible to insert a piece of cartilage between the flaps, and in this way more rigidity be obtained (Fig. 528).

Author's Method for Restoration of the Columna.—I have made a columna with two flaps of skin and subcutaneous tissue, extending transversely across the upper lip, just below the base of the nose. The pedicles were situated close to the midline near the anterior margin of the floor of the nose, and the free ends extended beyond

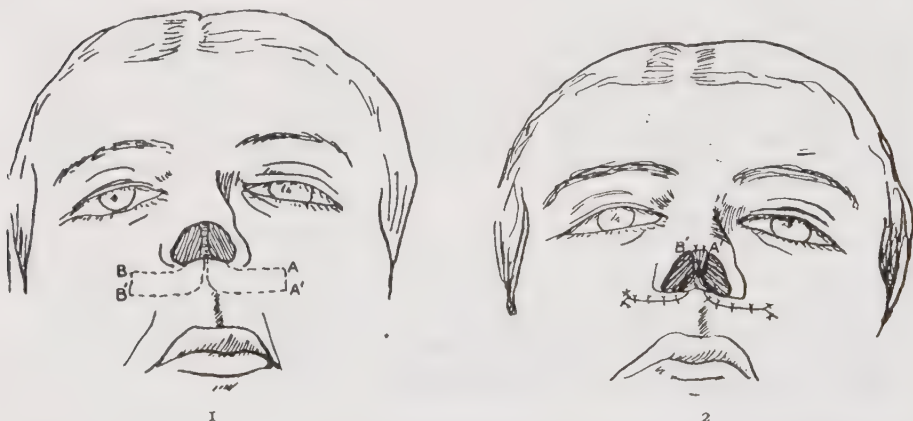


FIG. 529.—Operation for the construction of the columna.—1. The dotted lines indicate the outlines of the flaps consisting of skin and subcutaneous tissue. 2. Flaps raised and with the raw surfaces turned inward toward the midline are sutured together, raw surface outward. The free end of the approximated flaps is sutured to the tip of the nose.

the alæ. The flaps were raised and turned inward, raw surface to raw surface, and then the end of the double flap was sutured to the tip of the nose. The flaps should be cut wide enough to give the lip the desired shortening, and should be long enough to reach the tip of the nose without tension after being sutured together. The lip wounds left after raising the flaps are sutured (Fig. 529).

This type of operation for the reconstruction of the columna is suitable only for those cases in which the upper lip is very long. It accomplishes the double purpose of shortening the lip and forming the columna.

Ch. Nélaton's Operation for Restoration of the Columna with a Rigid Support.—A small curved incision with its convexity downward is made just below the septum. The soft parts above the alveolar process

are divided, and then with a gouge a portion of the rudimentary septum is removed, long enough to form the new columna. This rigid flap (bone or cartilage) is turned down so that its posterior extremity can be sutured to the tip of the nose. This brings mucous membrane outward and exposes the uncovered bones, or cartilage within. The circulation of the flap is preserved by the soft parts directly above the ends of the skin incision. Healing may be stimulated by wrapping a thin Ollier-Thiersch graft around the newly formed columna or the chance of having some of it adhere to the raw surface (Fig. 530).



FIG. 530.—Ch. Nélaton's operation for the restoration of the columella (*Duvernoy*).
1. Through a curved incision the gouge is raising a portion of the rudimentary septum consisting of mucous membrane, bone and cartilage, with its base at the upper lip. The rigid flap is turned forward, and attached to the tip of the nose.

Secondary Rhinoplastic Operations

Only rarely can a rhinoplastic operation of any extent be done without a number of secondary operations to shape and mold the transplanted tissue. Many of these retouching operations are all used to correct malformations of the nose (simply to improve appearance), but in the latter group the operator is usually fortunate enough to have normal tissues to deal with and not scar infiltrated material.

These trimming and shaping operations are extremely difficult and a bad situation is often made worse by an unskillful operator or a poorly planned operation.

Oblique Nose

After rhinoplastic operations the nostrils may not be of the same height. For correction in these cases several operations have been devised.

Dieffenbach's Operation.—An incision made in the midline the full length of the nose. A triangle of tissue of the desired size with its base at the midline is removed from the long side. The incisions are closed (Fig. 531).

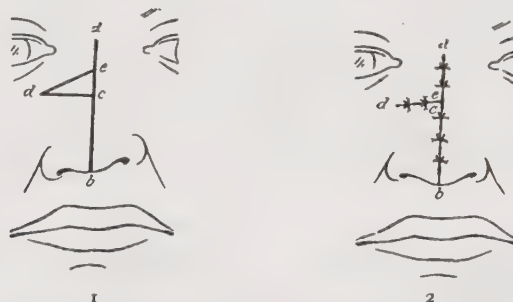


FIG. 531.—Dieffenbach's operation for the correction of an oblique nose (*Szymanowski*).—1 and 2. The incision *db* is made through the soft parts in the midline, from the root to the tip of the nose. The triangle of tissue *cde* (which should vary in width according to circumstances), is removed, and the wounds are closed.

J. Joseph's Operation.—An irregular elliptic-shaped section of tissue, including the full thickness, is removed from the long side of the nose. This section is obliquely placed and extends from the edge of the ala to beyond the midline. The width depends on the extent to which the nose is to be shortened. The wound is then closed (Fig. 532).

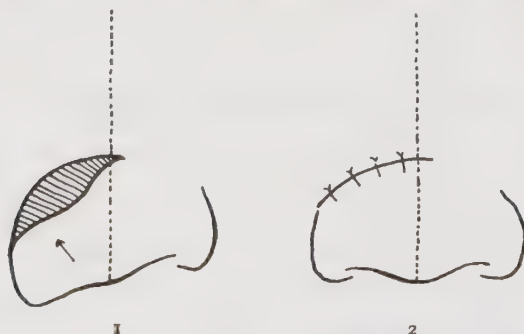


FIG. 532.—Operation for the correction of a lowered ala (*J. Joseph*).—1. The shaded portion represents the area excised, including skin, cartilage and mucous membrane. 2. The defect closed and the ala brought up into proper position.

In both of these operations no permanent good can be accomplished unless, in an additional procedure, the ala on the affected side is separated from the cheek and raised.

To Reduce the Size of the Nose

If the newly made nose is too large it may be reduced by removing sections of the skin and underlying tissue. When the nose is naturally

large, or has been increased in size by trauma, in addition to the skin sections of the nasal and septal cartilages may have to be removed, before any permanent result is obtained (Mikulicz, Joseph, Kolle, and others).



FIG. 533.—Dieffenbach's operation for reducing the size of the nose (Szymanowski).—1 and 2. The shaded area indicates the defect left after the excision of a vertical and horizontal segment of skin and subcutaneous tissue. A similar excision should be done on the other side of the nose, and the wounds then closed.

The bridge of the nose may also be very prominent, either naturally or following injury. This prominence may be reduced by trimming the bone and cartilage subcutaneously through an incision at the tip.

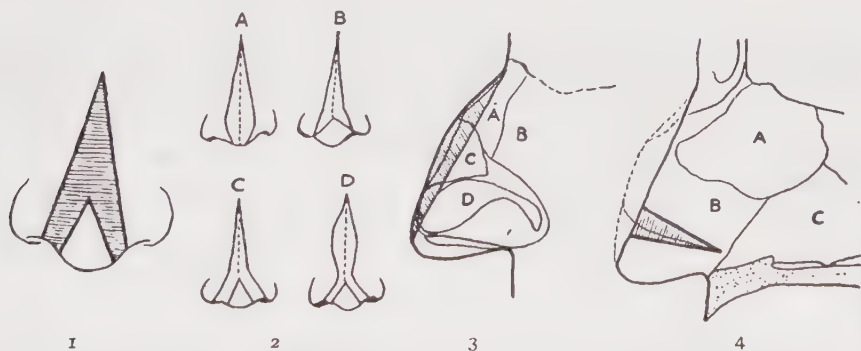


FIG. 534.—Joseph's operation for reducing the size of a large nose (Roberts).—Shaded portion indicates area of tissues excised. 2 A-D. Other shapes which may be excised to suit conditions. 3. A. Nasal bone. B. Maxillary bone. C. Triangular cartilage. D. Cartilage of the ala. The shaded portion indicates the tissues removed. 4. A. Ethmoid bone. B. Quadrangular cartilage. C. Vomer. Shaded portion indicates the area removed.

of the nose (Monks); by the submucous method of Roe, and other or by the external method. There is practically no visible scarring following the first two methods, but my own preference in these cases for direct exposure through a midline, a lateral, or a transverse curved incision over the bridge, depending on conditions. The soft par



1 2

FIG. 535.—Prominent and thickened bridge of nose caused by repeated trauma.—1. Before operation. The case was complicated by the occurrence of lupus of the skin on the bridge. For this reason it was necessary to excise all of the involved skin. After this was done a sufficient amount of bone and cartilage was removed to reduce the prominent size of the bridge, and the length was also reduced slightly. On account of the excision of the skin the defect was grafted. 2. Result four months after operation. The scar on the bridge is the area grafted. In a case of this type without skin involvement, operated on by the open method very little scarring follows.



FIG. 536.—Operation for reducing the size of the nose (*Mikulicz*).—1. The lower portion of the septum is divided along the dotted line CD and is removed; the tip of the nose is incised along the line BC. 2. The tip A, is attached to the upper lip. The flap BCD, is folded in to line and form the border of the nostrils.

are divided and retracted until the bone and cartilage are exposed and the desired amount is removed from the bridge and from the sides. The soft parts are then closed, and firm pressure is made over the site of operation.



FIG. 537.—Deformity following the injection of paraffin to correct a saddle nose.—1. Note the great thickening between the eyes and on the bridge of the nose due to the injected paraffin. Also the deep puckered groove on the side of the nose. A considerable amount of the infiltrated tissue was removed in several operations. 2 and 3. A pedunculated flap from above (see median scar) with its pedicle below, was turned down to fill the groove on the side of the nose. Several other shaping operations were done. 4 and 5. The result two years later. Note the shape of the bridge.

To Lengthen the Nose

A nose which is too short may be lengthened by the inverted V-shaped incision, the point of which is in the midline about on the level



FIG. 538.—Pirogoff's operation for lengthening the nose (*Szymanowski*).—1 and 2. The dark line indicates the V-shaped incision. The tissues are loosened, the tip is pushed down, and the wounds are closed.

of the canthi, the ends of the legs being in the fold between the cheek and nose just above the alæ (Fig. 538).

The flap is raised, adhesions are loosened, and the wound is closed in the form of an inverted Y. The success of this simple method depends on the normal condition of the tissues, and at best it is not very successful when the nose is too wide.

To Narrow the Nose

Szymanowski's Operation.—A broad triangle of tissue with its apex in the midline just above the vermilion border and its base extending from the inner edge of the ala on one side to the inner edge on the

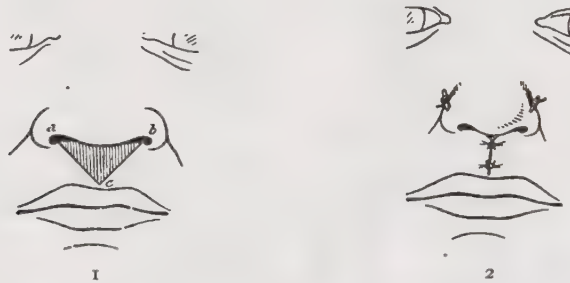


Fig. 539.



Fig. 540.

Szymanowski's operations for narrowing the nose.

FIG. 539.—1. The shaded area indicates the size and shape of the broad triangle of tissue removed from the tissue of the upper lip. 2. Shows the edges sutured.

FIG. 540.—Two triangular areas may be removed instead of one.

other, is removed from the upper lip. The alæ are loosened, and the wound is closed in the midline. The tissues are held together by a traction stitch through the base of the nose (Fig. 539).

The removal of a triangle of tissue from beneath each nostril, a strip of skin being left between, will accomplish the same purpose with less damage to the upper lip (Fig. 540-541).

To Raise a Flattened Nostril

Szymanowski's Operation.—The ala is detached by a transverse incision through the full thickness of the tissues just above the flat-

tened nostril. Next, a cut perpendicular to the first incision is made down through the border of the nostril. The tissue inside the nose

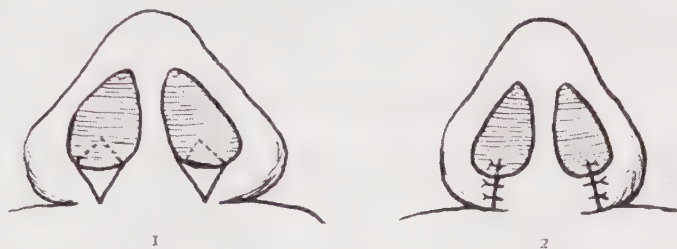


FIG. 541.—Operation for narrowing the base of the nose (*Kolle*).—1. The dark and also the dotted lines indicate the incisions made for removal of tissue. 2. The edges approximated.



FIG. 542.—Operation for elevating an abnormally flat nostril (*Szymanowski*).—The solid line indicates the T-shaped incision through the full thickness of the nostril. The insert indicates the method of closure of the edges after beveling the margins.

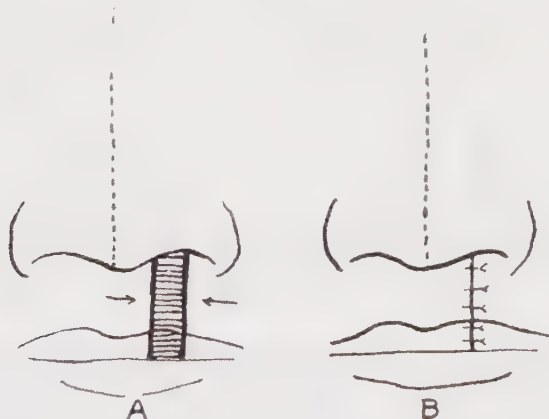


FIG. 543.—Operation for correcting an abnormally flat nostril (*J. Joseph*).—A. The shaded area represents the tissue excised through the thickness of the lip. B. The edges are closed as in an operation for harelip.

along the margins of the flaps is beveled, and the edges are closed (Fig. 542).

J. Joseph's Operation.—A section is removed through the full thickness and height of the lip, extending from the center of the nostril

down to and including the margin of the lip. The width of the strip depends on the amount of narrowing desired. The ala on that side must be thoroughly freed before suturing (Fig. 543).

To Lengthen the Ala

Polaillon's Operation.—Two curved flaps adjacent to each other are raised, the one being formed by the outer end of the ala and the



FIG. 544.—Operation for lengthening the ala (Polaillon).—1 and 2. The flaps *mno*, and *nop* are raised. *nop* is drawn forward and sutured beneath the other flap, which is stretched outward, and sutured into the cheek defect.

other from the cheek, as shown in the diagram. The cheek flap is drawn under, the ala flap is stretched outward to fill the defect left by shifting in the cheek flap, and both are sutured in position (Fig. 544).

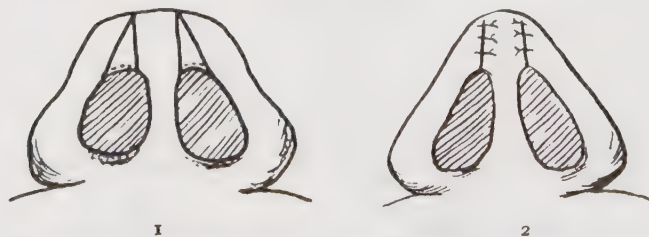


FIG. 545.—Operation for lengthening and narrowing the alæ (Kollé).—1. The dark lines indicate the incisions for the outer triangles of the diamond-shaped pieces of tissue to be removed. The bases of the triangles meet at the anterior rim of the nostrils. 2. The edges sutured.

To Reduce the Thickness of the Ala

Reduction in the thickness of the ala is often necessary, especially after double thickness flaps have been used to construct the nostrils. This is best accomplished by the excision of elliptical sections from the margins (Linhart, and others) (Fig. 546).

Atresia of the Nostrils

Atresia of the nostril is exceedingly difficult to correct. It may occur after rhinoplastic operations, or may be caused by disease. If atresia is accompanied by loss of substance, then it is best to perform one of the operations previously described, and completely reconstruct



FIG. 546.—Operation to reduce the thickness of the alæ (*Linhart*).—Elliptical-shaped sections of tissue are removed from the alæ, and the wounds are closed.

the nostril. The restoration may be made by the Italian method, or in suitable cases, by that devised by Jalaquier.

Jalaquier's Operation.—A narrow quadrilateral flap is raised from the naso-labial tissue below the nostril, with its pedicle above and continuous with the ala. The ala is then completely detached and the under surface of the quadrilateral flap is sutured to the raw internal



FIG. 547.—Operation for the relief of atresia of the nostril (*Jalaquier*).—1. The flap A (which is continuous with the ala) is raised, and after freeing the nostril it is turned under and forms the lining of the ala. The flap B is then raised and is shifted down to fill the defect left by raising A. 2. Shows the flaps in position, and the wounds closed.

surface of the ala. A long quadrilateral flap is then raised from the cheek with its pedicle at the base of the ala. This is shifted and sutured into the defect made by raising the first flap, care being taken to shape the posterior border to form the ala when suturing the cheek defect (Fig. 547).

Absence of the Nose (Congenital)

For the correction of this very rare condition, Maisonneuve's procedure may be effective.

Maisonneuve's Operation.—A V-shaped incision is made through the full thickness of the lip, with its apex exactly in the midline at the vermillion border. The arms of the V end at the points where the nostrils should be, and from these points horizontal incisions are made outward as far as may be necessary. The skin above the horizontal

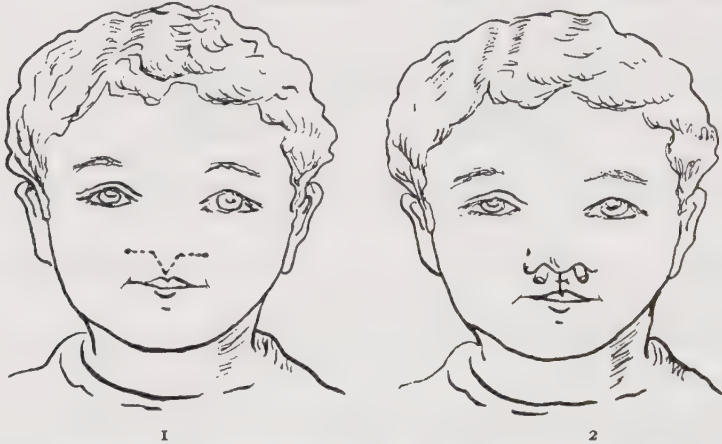


FIG. 548.—Operation for the construction of a nose (*Maisonneuve*).—The dotted lines indicate the incisions through the lip. The tissues are undercut and brought forward, the V is raised and the incisions are sutured.

line is loosened and brought forward. The V-shaped flap is then shifted upward to form the columna. The lip defect is closed. Tubes are placed in the nostrils until healing is complete (Fig. 548).

The result can be improved by the implantation of a cartilaginous support, and a secondary operation to enlarge the nostrils.



FIG. 549.—Operation for narrowing and lengthening the columna (*Gensoul*).—1. The shaded area indicates the defect left by excising an ellipse of tissue. The solid line indicates the incision. 2. All incisions closed.

Reduction of a Thickened Columna, and Advancing the Point of the Nose

Gensoul's Operation.—A deep incision is made from the floor of each nostril downward and inward, the two meeting at a point just

below the union of the septum and the upper lip and forming a V. The tissues are loosened, the nose is drawn forward, and the wound is sutured in the shape of a Y. The columna itself is narrowed by the removal of an ellipse of tissue and the skin is sutured (Fig. 549).

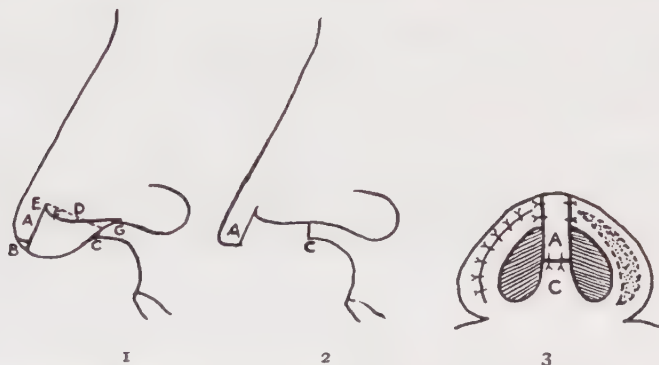


FIG. 550.—Operation for correcting an elongated lobule (*Kolle*).—The scalpel is passed through the nose at the point E, and is carried down through the tip. From E to G the ala on each side is trimmed. From C to E the septum is trimmed. The tip B of the flap A is cut away and the end of the flap A is sutured to C. The cartilage of the ala is trimmed and the sulcus is closed.

The base of the nose is sometimes too wide, and this may be corrected by the removal of a diamond-shaped section from the posterior rim of the nares (*Kolle*).

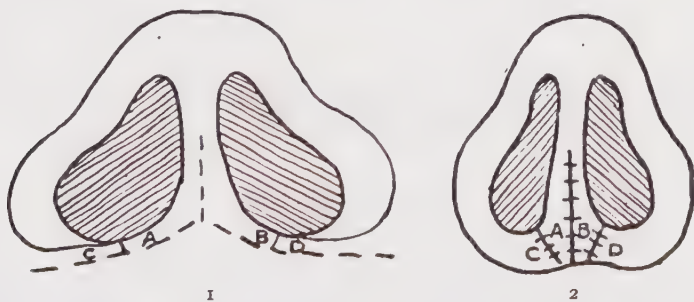


FIG. 551.—Operation for lengthening the columna (*Carter*).—1. The dotted line shows the inverted Y-shaped incision which divides the columnar cartilage and is continued under the floor of the nostrils, making two flaps, A and B, which are united in the midline. 2. The incisions in the floor are then extended under the alae liberating them, so that they can be brought toward the midline, thus narrowing and lengthening the nose.

The Correction of Lobe Defects

Kolle's Operation for Correction of Broad Lobe.—A diamond-shaped piece of tissue is removed from either side of the columna. The tissues are loosened and the wounds are sutured.

An *elevated lobe* may be lowered by removing the anterior third of the columna, with a triangular section of the cartilaginous septum above (Kolle).

Bifid Nose

Bifid nose is a rare congenital deformity in which the two halves of the nose have not been normally joined in front. A long vertical depression remains in the midline; the nose is broad, and double pointed.

The simplest method of correcting this deformity is to remove an elliptic-shaped piece of skin and underlying tissue (of sufficient size) from the depression and bring the edges together.

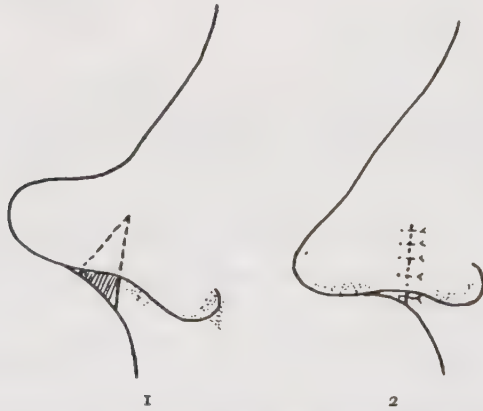


FIG. 552.—Operation for correcting an elevated lobule (Kolle).—1. The shaded area and dotted lines indicate the amount of septum and columna to be removed. 2. The lobule restored to normal and the edges sutured.

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CHAPTER XX

PLASTIC SURGERY OF THE JAWS, LIPS AND CHEEKS

GENERAL CONSIDERATIONS

The early treatment of wounds of the soft parts has already been considered in the Section on the Healing of Wounds. Suffice it to repeat here that when there is bone destruction, early suture of the soft parts is indicated, done over the proper prosthetic apparatus in order to prevent shrinkage. Nevertheless, it must be remembered that when this closure is done merely for its own sake, and at the expense of future function of the jaws, a fundamental principle is violated. Where there has been extensive destruction of tissue, the wounds should be allowed to heal firmly before shifting flaps. The flaps should be planned in such a way as to make the scars of the wounds from which they are raised as inconspicuous as possible. When feasible, all incisions should be made along the natural folds, or under the angle of the jaw.

In cheek or lip plastics in old cases, as far as possible scar tissue should be excised and the mucous membrane and skin surface thoroughly separated down to normal tissue. In closing cheek or lip wounds after the excision of scar tissue, or in any operation on the face in which tension sutures are required, the buried type is to be preferred. Drainage should be provided whenever necessary.

After operation the parts should be immobilized as completely as possible, and talking should be discouraged. Liquid food should be administered through a nasal tube to avoid soiling, and the mouth must be kept clean with irrigations, which should be most carefully given.

After healing has taken place, and the defects are filled, much can be done to improve the appearance by secondary operations.

In shifting a flap from the temple a part may be of hairless and a part of hairy skin. Advantage may be taken of the hairy portion in forming an upper lip, or reconstructing the hairy portion of the cheek.

An important preliminary preparation for all operations on the jaw

and cheek or lip is the removal of decayed teeth and stumps. Not until the condition of the mouth is satisfactory should the operation be performed.

Anesthesia.—Much can be done under local anesthesia, either by nerve blocking or infiltration. Not infrequently an operation may be started under a general and finished under local anesthesia, or vice versa. If a general anesthetic is used it should be given through nasal or pharyngeal tubes. In either, in order to obtain a relatively clear field for operation after proper disinfection with ether and one-third strength tincture of iodine, the mouth should be packed with dry sterile gauze. The packing has the additional advantage of preventing the aspiration of blood.

In those cases in which there is locking of the jaws especial care must be taken in the preliminary preparation, as vomiting may be disastrous.

Preparation.—Fresh wounds due to trauma should be thoroughly washed with ether, followed by one-third strength tincture of iodine. This technic is also satisfactory in the mouth and on the cheek and lips. Every effort should be made to preserve asepsis. It is true that this is extremely difficult in operations around the mouth, but no relaxation in technic should be tolerated.

SURGERY OF THE JAWS

In reconstruction of the jaws our principal aim is to rectify defects in the framework which supports the overlying soft parts.

In civil practice the plastic surgeon is occasionally called upon to correct the deformity which follows removal of more or less extensive sections of the jaws for malignant growths. The majority of these cases, however, are referred only after contracture has taken place and often when nearly all chance of obtaining a good result has disappeared.

The great number of war wounds of the jaws in the last four years has increased the interest in this subject and many advances have been made in the methods of treatment. I wish again to emphasize the great importance of a close and early coöperation with the dental surgeon in dealing with loss of substance in the jaws. The dental surgeon should be responsible for constructing and placing a temporary prosthetic apparatus which will prevent contracture of the soft parts and at the same time keep the fragments in position until the gap can be filled with bone or cartilage; or, if the destruction is too great for

plastic help he should institute the proper permanent prosthesis. The plastic surgeon should attend to the transplantation of bone and the reconstruction of the missing soft parts.

Whenever the general surgeon undertakes destructive operations on the jaws without the coöperation of the dental surgeon, he is not giving the patient the benefit of the best treatment. Nevertheless, strange to say, before this war this was seldom done, and even today some surgeons do not appreciate the importance of such help.

Recent Injuries

Ordinary fractures without loss of substance (or with only a small bony loss which will probably regenerate) are of no particular interest to the plastic surgeon, except as a secondary matter in connection with extensive destruction of soft parts. On the other hand, his part begins whenever there is enough destruction of bone following operation; disease or trauma, to call for reconstructive work. Associated with the loss of bone there is usually more or less laceration or destruction of the cheeks or lips, and these must be reconstructed or repaired over the proper prosthetic apparatus to preserve the desired contour, before we proceed to bone transplantation. Moreover, all pathological and inflammatory conditions should be cleared up and sufficient soft parts be provided to hold the transplant. In all fractures of the jaw, with or without loss of substance, early splinting is essential, and if there is accompanying laceration or destruction of the soft parts early closure (if this is possible) is of great importance in order to avoid subsequent contracture. In many instances of extensive loss of the soft parts, skin and mucous membrane may be sutured together temporarily, because much may be gained by this maneuver in hastening healing, and minimizing the formation of scar tissue. Teeth should be preserved, even if loosened, and all bony fragments, which are not obviously useless, should be saved.

Where there is loss of bone correct alignment is of the greatest importance, with bony union if feasible. But if this is not possible without deformity, the alignment should be maintained by means of a temporary prosthetic apparatus until the gap (if not too large) can be filled with bone.

The ultimate test of the utility of any method of reconstruction of the mandible is the ability of the patient to masticate ordinary food. As has been demonstrated clinically, this is possible provided

the occlusion is good, even if the union is not perfectly solid. Buried prostheses of wire, vulcanite, and other materials, have been used to fill defects in both upper and lower jaws, but their use is not to be recommended. Since the present work deals with plastic surgery, I shall not refer to the various methods employed in plating, wiring, or splinting, but shall describe only those connected with the use of free bone grafts and pedunculated flaps with attached bone.

EXTENSIVE DESTRUCTION OF THE MANDIBLE AND THE SOFT PARTS

In a recent article by Kazanjian and Burrows, in speaking of war wounds in which there is extensive destruction of the mandible and also of the soft parts, they emphasize the fact that the early effort of the surgeon must be directed toward treating shock, checking hemorrhage, combating infection, removing foreign bodies, fragments of bone and soft parts which are without vitality, providing drainage, and supporting the part. Frequent irrigation and changes of dressings are necessary. Traumatic edema of the tongue and glottis may occur and in extensive wounds the support of the tongue may have been destroyed so that, unless the patient is kept in a sitting position with the head forward, the tongue will drop back and obstruct the breathing. Tracheotomy should be done at once if the sitting position does not relieve the obstruction. Unless absolutely necessary a general anesthetic should not be given, as aspiration pneumonia may occur. When sloughs and sequestra have been cast off and the granulations begin to be healthy, some of the secondary suturing may be done.

It is best to feed the patient through the nares, although an esophageal tube may sometimes be used. As soon as conditions are favorable the fragments of the mandible must be put into the proper position and held by means of a temporary splint. The alignment should be directly under the alveolar ridges of the upper jaw, and sufficient intermaxillary space should be allowed. If teeth remain on the fragments the splint is fastened to them; if no teeth are present, a removable vulcanite splint is made to fit over the fragments.

It is important to preserve the buccal sulcus if it still remains. If it has been destroyed the mucous membrane should be divided along its attachment to the alveolar ridge, a deep incision made along the margin of the jaw, the cut mucous membrane edge drawn down into this with sutures, the sulcus reestablished and maintained by means

of flanges attached to temporary splints. Before the soft parts are closed an artificial jaw of normal size, made of vulcanite, is worn for a time; then the plastic closure is done, and still later a permanent artificial jaw is made.

One of the most serious complications in gunshot wounds of the face and jaws is secondary hemorrhage, which occurs most frequently between the fourth and twelfth days, but has been reported as late as the forty-fifth day (Kazanjian and Burrows). The cause of the hemorrhage is usually sepsis, or injury to the vessel by foreign bodies. It is treated by digital pressure, properly applied packing, or by catching and ligating the bleeding vessel. Occasionally it becomes necessary to ligate the external carotid artery.

RECONSTRUCTION OF THE SUPERIOR MAXILLA

As a rule little can be done by plastic methods to reconstruct the upper jaw after loss of substance, although Morestin has been able in several cases, after repair of the soft parts, to reconstruct the superior maxilla partially by means of costal cartilage. The deformity due to the loss of bone framework can be much improved, however, by some prosthetic apparatus which will fill out the buccal depression, separate the nasal from the oral cavity, and restore the masticating surface.

RECONSTRUCTION OF THE MANDIBLE (LOWER JAW)

The reconstruction of defects in the mandible may be accomplished by interposing bone or cartilage between the fragments. There are two general methods of filling the gap: (1) By the free transplantation of bone or cartilage; (2) *a*, by the transplantation of a pedunculated flap of skin, or of skin and muscle from which the bone has not been separated (usually a portion of the clavicle); *b*, by shifting in a section of bone from the mandible itself, without detaching it from the soft parts. This latter method cannot be used in large defects.

The transplantation of bone to fill a defect in the mandible whether free or attached to a pedunculated flap, must not be undertaken until healing is complete, and all avoidable chances of infection have been eliminated. The gap should not be filled for at least six months; a still longer period must elapse before the final result can be determined.

It may be quite difficult to expose the mandible fragments with-

out opening into the mouth, and if this should occur the operation should be abandoned temporarily. Early infection, at the time of operation, will usually destroy the transplanted bone completely, but if the gap is not too wide sufficient callus may form to bridge the defect. Late infection (after several weeks) may not injure the graft, or only a portion of it may slough. Cartilage will be found much more resistant to infection.

If the gap is less than 1.25 cm. ($\frac{1}{2}$ inch) long, union by natural growth may be expected, but if it is more extensive, bony union without interposition of bone is doubtful. Defects of the mandible larger than 3. to 3.5 cm. ($1\frac{1}{5}$ to $1\frac{3}{5}$ inches) should be repaired with free bone grafts, or with pedunculated flaps to which bone is attached. The loss of nearly all of the horizontal ramus on one side makes the utility of bone transplantation somewhat uncertain, although some good results have been reported after even greater destruction; in these cases the use of a permanent prosthetic apparatus has to be considered.

When bone or cartilage is transplanted, immobilization of the mandible and the transplant is important. This is usually accomplished by some apparatus that will fix the lower teeth to the upper but the fixation may also be in the "open bite" position to avoid constriction. The bone grafts may be secured with plates, by wiring or by forcing the ends of the graft into slots cut in the mandibular fragments.

The Use of Bone or Cartilage Grafts.—Gallie and Robertson's operation for the transplantation of free bone to fill defects in the mandible is simple and satisfactory. They report good results in filling gaps from 2.5 to 5. cm. (1 to 2 inches) in length. The fragments are exposed by an incision along the lower border of the jaw. Then with a motor saw a cut is made 1.25 cm. ($\frac{1}{2}$ inch) deep and from 2.5 to 5. cm. (1 to 2 inches) long, along the inferior border of each fragment. Care should be taken not to open into the mouth, or into a tooth socket. With an osteotome the saw cuts are spread apart, and a wedge-shaped gap is made in each fragment for the reception of the graft. An interdental splint which has been previously connected to the teeth of both jaws is now locked, with the teeth in exactly the correct relation to each other, and this is used throughout the treatment. Seven and a half centimeters (3 inches) or more of bony rib is removed and the rib is split lengthways on the flat. Half of the piece is then forced into the prepared slots, the smooth side being toward the mouth, while the other half of the graft (smooth side out) is shortened and placed

between the fragments on the exposed surface of the piece of rib wedged into the slots. The whole is secured with kangaroo tendons passed through drill-holes, and the soft parts are closed (Fig. 553-554).

Cole transplanted free bone after preparing a bed for it. After placing a section of decalcified bone between the fragments and allow-

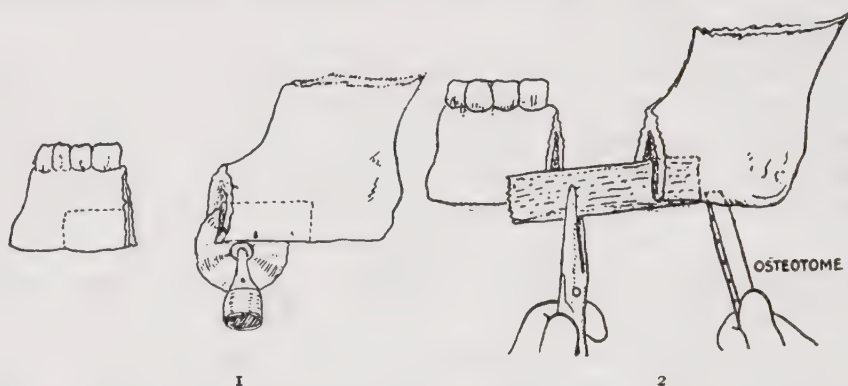


FIG. 553.—Method of closing a gap in the mandible with free bone grafts (*Gallie and Robertson*).—1. The dotted lines indicate the slots made with the motor saw. 2. The split half of the rib with smooth surface toward the mouth cavity is placed in the slots which have been widened with the osteotome.

ing it to remain for three months, he removes it and implants a free graft from the rib or tibia, which he secures to the fragments with silver plates. (The bed into which the graft is to be eventually placed has also been formed by implanting temporarily, pieces of celluloid, vulcanite, or metal.) Cole has successfully filled defects varying from

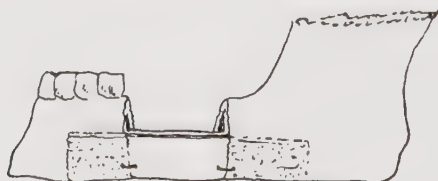


FIG. 554.—Gallie and Robertson's method, *continued*.—A portion of the other half of the rib is placed between the ends of the fragments in contact with the first half, smooth surface outward, and all are secured by kangaroo tendon sutures.

2.5 to 7.5 cm. (1 to 3 inches), and says he has had 70 per cent. of successes.

Morestin has used shaped pieces of free cartilage to fill defects in the mandible. He has found that with the cartilage he can restore the contour and prevent recurrence of the deformity, and in addition

can obtain good functional results, although the union between cartilage and bone is not perfectly rigid.

The Use of Pedunculated Flaps with Bone Attached.—Peunculated flaps from the neck or chest to which are attached bone from the clavicle, have been used to close defects in the mandible. These flaps may be composed of skin and bone, or skin muscle and bone. The operative procedure is extensive and causes a good deal of mutilation and much subsequent scarring. In certain cases which call for a long piece of bone not detached from its overlying soft parts, this method is of value (Fig. 555).

My experience has shown it to be poor surgery to attempt the repair of the mandible and the soft parts at *the same time*. The soft parts



FIG. 555.—Method of closing a defect in the mandible and reconstruction of the lower lip at the same time (Blair).—1. The dotted line indicates the proposed flap. A section of bony rib has been previously transplanted between the skin and the platysma muscle. 2. The flap raised, the bone being grasped in forceps to avoid displacing it. 3. The flap in position. The bone has been wired into the defect in the mandible. The end of the skin flap is turned over to line the lip. This operation may be modified by using a section of the clavicle. On the cadaver the method is admirable, but in actual practice it is without value.

should be reconstructed first over the proper prosthetic apparatus and only after healing is complete, and after a considerable period of time has elapsed, should the defect in the mandible be filled. It is true that this procedure appears to take much longer, but in the end time will be saved. In this type of work there is no short cut to success.

If a pedunculated flap with a portion of the clavicle attached is used, the bone should be implanted between the fragments with exactly the same precautions as when a bone graft is transplanted, and should there be accidental opening into the mouth cavity the operation should be postponed. The bone may be implanted in adjacent soft parts for several weeks (Imbert and Réal) and then shifted in, the soft parts

being utilized as a pedicle. This method has little to recommend it, for unless the transplantation is done within three weeks, absorption of the bone will begin and continue until the bone eventually disappears. On the other hand, this procedure can be successfully carried out with cartilage, which will not change in size; hence in certain cases it may be the method of choice.

Pedunculated Flap from the Mandible.—Cavalié, Cole, Esser, and others, have used pedunculated flaps from the mandible itself. *Cole's method* is simple and efficient, and an outline of his technic follows: A wide skin flap extending from the symphysis to the angle of the jaw is raised from the neck to the desired level. The posterior fragment is



FIG. 556.—Method of repairing a defect in the mandible with a pedunculated bone flap (Cole).—1. The posterior fragment exposed and freshened. An incision is made through the soft parts over the outer aspect of the anterior fragment, and then through this incision with a saw a fragment is loosened. 2. The bone fragment attached to the soft parts as a pedicle. 3. Wire sutures in place which will draw the flap of bone and soft parts into position.

thoroughly exposed, but only enough of the anterior fragment to show the width of the defect. A horizontal incision is made through the soft parts covering the outer aspect of the anterior fragment at a level immediately below the buccal sulcus. The basal margin of this portion of the jaw is then sawn off through the incision mentioned above. The periosteum on the inner aspect is then divided and lateral incisions through the platysma and deep fascia are made to form the pedicle which is loosened. If necessary the bone flap may be obtained from the mandible on the other side, the anterior belly of the digastric muscle being used as a pedicle. The ends of the mandibular fragments are freshened and the flap is shifted into the defect and secured with silver wire, which passes through the fragments through the pedicle and around the transplant. Drainage is provided and the soft parts are closed (Fig. 556).

Cole's experience has led him to prefer this method instead of free

bone grafts in all cases in which the gap is not over 3. cm. ($1\frac{1}{5}$ inches) wide. He suggests the use of bilateral pedunculated flaps for repair of the symphysis.

This, or some similar method of using a flap from the jaw has much to commend it. It is a simple procedure as far as manipulation is concerned, the circulation in the bone is assured, and the results are more promising than with free grafts.

Irregularities of the Mandible.—We often see a quite marked bulging or a depression of a portion of the lower jaw without interference with function. It is possible to remove the prominent area by chiseling off the bone. Depressions may be obliterated by placing properly shaped pieces of cartilage in the defect, and securing it to the bone. The periosteum may, or may not be opened according to the necessities of the operation. The incisions for both of these procedures should be made under the angle of the jaw.

CONSTRICTION OF THE JAW

Trismus.—Many cases of trismus of the muscles of mastication have been found following fractures (with or without loss of substance), or slight wounds of the soft parts. Much can be done to avoid this condition by the use of the "open bite" splint. Trismus may be successfully treated by gradual continuous stretching of the muscles.

Sclerosis of the Muscles.—In other cases the presence of a sclerosis of the muscles of mastication renders stretching practically useless. We often find this type in old cheek or lip defects, due to ulceration or infection, and in these the operation of *Le Dentu*, so successfully used by Morestin, is of great value. The procedure is as follows: An incision, 3. cm. ($1\frac{1}{5}$ inches) long, is made behind the angle of the jaw. The insertions of the masseter and internal pterygoid muscles are exposed, and with a knife and elevator loosened from the mandible. The wound is then sutured. In this way the constriction is relieved and the jaw is opened widely and braced with a wedge for three days. One or both sides may be treated, as may be necessary. A few days later the patient is able to masticate without difficulty.

The treatment of *ankylosis of the jaw* caused by involvement of the joint is essentially an orthopedic problem, and will not be considered here. I might say, however, that excision of the condyle with a portion of its neck is the best procedure.

RECONSTRUCTION OF THE ORBITAL RIM AND THE MALAR BONE FOLLOWING INJURY

Occasionally in civil practice, and often in the injuries of war, the plastic surgeon is called upon to correct deformities following the destruction of the malar bone and the various portions of the orbital margin.¹ The absence of the bony framework causes a deep depression, which cannot be corrected unless the framework is reconstructed. Accompanying these depressions there is usually extensive deep-seated scarring and great deformity. Not uncommonly the eye and one or both lids are destroyed.

Morestin has been able to reconstruct the framework by the implantation of either auto or isocartilage, usually taken from the sixth and seventh cartilaginous ribs.

The scar tissue is removed by gradual excision and healthy tissue is brought in from the edges. The lids, if any remain, are repaired and adjusted, or may be reconstructed. After this has been accomplished, the bone defect is exposed and the cartilage is shaped to fill the defect.

It is difficult to fasten the shaped cartilage securely to the bone (there is never rigid union between bone and cartilage), but much can be accomplished by mortising the edges and by utilizing any means which seems available for the particular case. I have found, experimentally, that sutures should not be put through the cartilage itself, as they tend to cause a fracture at that point, but may very well be inserted through the perichondrium.

A cuff of fascia lata may be sutured snugly around the opposed or mortised ends in certain situations.

The contour of the normal side of the face should be reproduced as perfectly as possible. The soft parts are then closed over the cartilage inserts. All portions of the orbit may be reconstructed in this manner. In certain cases free fat grafts may be used in conjunction with the cartilage with excellent results.

DEPRESSED FRACTURES OF THE MALAR BONE

At times depressed fractures of the malar bone cause great deformity of the cheek. If the injury is old, then considerable difficulty may be

¹ When excising the superior maxilla, if it is possible, the floor of the orbit should be preserved by some such method as that described by Van Hook, as in this way sagging of the eye-ball is prevented, and repair of defects in this portion of the cheek is much simplified.

experienced in bringing the fragments into proper position, and it may be necessary to expose the bone through a skin incision. Before this is done, however, the attempt should be made to elevate the bone by means of a pair of "cow horn" dental forceps, which grasp the bone through the skin, as suggested by Manwaring. A good grip of the bone can be obtained by placing one point of the forceps over the orbital ridge, and the other under the margin of the body of the bone at its outer side, and there is little or no scarring of the skin.

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CHAPTER XXI

SURGERY OF THE LIPS (CHEILOPLASTY)

General Considerations.—Defects or other deformities of the lip calling for plastic surgery may be due to congenital malformation, trauma, ulceration (syphilis, etc.); very frequently to burns and the excision of growths. Except for harelip, which has been previously considered, plastic operations on the lower lip are required much more frequently than on the upper.

In reparatory operations on the lips we endeavor to construct a mouth of proper size which can be opened and closed without difficulty. *The lips must be lined with mucous membrane or skin*, to avoid subsequent contracture; they should be of normal shape and have a vermilion border. The lower lip should be sufficiently high to cover the teeth in order to avoid drooling and the escape of food during mastication.

Any portion of either lip may be destroyed or distorted, or both lips may be implicated and call for reconstruction separately, or at the same time.

It is very important that the vermilion border be restored because the lip will then be much more flexible and the appearance much improved. The vermilion border is very extensible, and even if only a small portion remains, by stretching and shifting it can be made to form the border of the new lip. It has been suggested that a vermilion border be tattooed on the skin, but this expedient will furnish only a poor substitute for an edge consisting of mucous membrane. Hence the method should be discouraged.

The elasticity and stretching capacity of tissues around the mouth is remarkable, and to this we owe our ability to carry out some of the most common procedures. One-half and possibly a little more of the lower lip may be excised without excessive narrowing of the buccal orifice.

As far as possible incisions should be made to follow the natural lines of the face, and the flaps planned so that distortion and asymmetry will be avoided. It is especially important that the commissure should be lined with mucous membrane, and that mucous membrane should be sutured to the skin in the formation of the new lip, for

this can be done, cicatricial contracture is prevented, and much subsequent discomfort avoided.

In all of these operations in which flaps through the full thickness of the cheek are used the mucous membrane should be divided about 1. cm. ($\frac{2}{5}$ inch) above the skin incision, thus giving a flap which can be sutured to the skin to form the new vermilion border. In planning flaps to reconstruct a lip they should be wide enough to cover the teeth, and long enough to be sutured into position without tension.

In the restoration of the lips three methods may be used either alone or in combination. (1) By simple gliding with traction of the pedicle (French method); (2) by a flap from neighboring tissue with more or less twisting of the pedicle (Indian method); (3) by a flap from distant parts (Italian method).

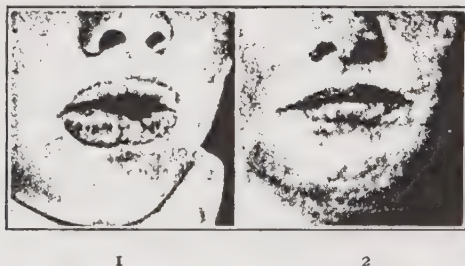


FIG. 557.—Hemangioma involving the vermilion border of the lower lip and the mucosa lining the lip.—1. Before operation. 2. After operation. An elongated ellipse of tissue was removed parallel to the length of the lip, and then a broad V-shaped area was removed, extending from the first defect to the gingivolabial fold. The edges were then sutured. No recurrence has followed.

In addition, skin grafting is often used to cover the raw surface after the correction of ectropion, but the results are seldom as satisfactory as when more radical procedures are employed.

The restoration may be done immediately, or after healing has taken place.

IMMEDIATE RESTORATION.—Defects following operative procedures should be repaired at once whether on the upper or on the lower lip, and repair should ordinarily be undertaken immediately in wounds in which there has been loss of tissue. In these cases the surgeon deals with normal tissues.

SECONDARY RESTORATION.—By secondary restoration is meant the repair of defects after the edges have completely healed. These defects may follow the excision of tumors in which immediate restoration was considered inadvisable, destruction following burns, and destructive

ulceration of various kinds. Many of the operations described under immediate restoration of both the upper and lower lip may be utilized after excision of the scar tissue edges.



FIG. 558.—Contracture of the face following a burn. Duration eight years.—1, 2 and 3. Profile view and front views of the patient. Note the ectropion of the lids, the inability to close the mouth and the general involvement of the entire face with scar tissue.



FIG. 559.—Contracture of the face following a burn, *continued*.—1, 2 and 3. Profile and front views of the same patient after numerous operations in which one or two who thickness grafts were used around the eyes, but elsewhere the improvement was made entirely by shifting flaps of scar tissue, sometimes only a fraction of an inch at a time. Note that the eyes can be closed. The lips can be brought together normally, and the principal lines of tension have been relieved.

I shall discuss the operation for malignant growths of the lip only from the standpoint of repair. I might say, however, that in eve

case of this type a wide margin should be allowed, and the shape of the excised area should be as uncomplicated as possible.

Ordinarily the glands in the neck are removed through incisions which are independent of those used for closure of the lip, but operations have been devised in which the glands may be removed through the same incisions. The advantage, of course, is obvious; there are fewer scars and the exposure is much better when a large flap is reflected.

The deformities and defects of the lips vary so much in situation, shape and extent that a great many operations have been devised for their correction, many of these differing only in detail.

RESTORATION OF THE UPPER LIP

Immediate Reconstruction.—The upper lip is the seat of malignant disease much more rarely than the lower, so that restoration following excision is less frequently required. In war wounds, however, many reconstructive operations on the upper lip have been necessary.

For partial loss of substance unilateral or bilateral flaps may be used. If the defect has the inverted V-shape, it can be corrected by suturing the edges at once, or later by freshening the edges and suturing. In wounds due to trauma in which it is deemed advisable to delay closure, the mucosa and skin should be sutured together and the repair postponed for a time, after which a modified harelip operation may be performed. For partial defects some have employed unilateral flaps with a lateral pedicle, as in the operation of Blasius who utilizes the portion of the lip above the defect and the adjacent tissues of the cheek. Unfortunately after this procedure the direction of the pull on the resulting scar is across the natural folds. Flaps from the lower lip have also been used (the reverse of Estlander's operation for the repair of the lower lip) but the method is inadvisable on account of the precarious blood supply. In any case, even if the flap lives, the result is asymmetrical.

In cases in which the outer portions of the lip below the alæ are not destroyed, Dieffenbach's operation may be used for either immediate, or secondary repair. A vertical incision is made in the midline. Beginning from the upper end of this, an incision is made on each side curving upward and outward around the alæ, through the full thickness of the cheek. The tissues on the sides of the defect are shifted downward to form the free border of the lip, and the points which are below

the alæ are sutured in the midline. Teale's operation is somewhat similar, and Lexer has modified it in order to give more freedom to the flaps by making horizontal incisions extending outward from the upper end of the incisions curving around the alæ.

The disadvantage of these operations is that in many instances the lip is contracted, and the nostrils may be nearly closed. It is well



FIG. 560.—Operation for the partial reconstruction of the upper lip (*Blasius*).—1 and 2. The flap X is shifted downward and inward, the lines CD and AB being sutured.

bear the method in mind, however, as occasionally in harelip with wide gap and very scant tissue some such method of relaxation may be necessary in order to make a closure.

COMPLETE LOSS OF SUBSTANCE.—Many of the methods which will be described for restoration of the lower lip cannot be employed for the



FIG. 561.

FIG. 562.

FIG. 561.—Operation for the reconstruction of the upper lip (*Dieffenbach*).—The dashed lines indicate the incisions. The flaps are loosened and shifted inward, being sutured in the midline.

FIG. 562.—Operation for the reconstruction of the upper lip (*Lexer*).—The dark line indicates the incisions. The transverse incisions give more freedom in shifting the flaps than is found possible in Dieffenbach's operation.

upper lip for the reason that injury to the facial nerve and Stenson duct would follow, and the nostrils would also be encroached upon.

BILATERAL FLAPS WITH LATERAL PEDICLES have been used by Lisfranc, who formed quadrilateral flaps by making horizontal incisions, the upper being on the level of the nostril, and the lower continuous with the commissures. The procedure is inadvisable for complete restoration, although it may be used in selected cases for partial restoration.

Burow, and C. Bernard's modification of Lisfranc's method consists in the excision of four triangles of normal tissue, in order to remove redundant tissue and to facilitate the shifting of the flaps.



FIG. 563.—Operation for closing a defect in the upper lip (*Grant*).—The growth is excised and lateral flaps are made through the full thickness of the lip. They are shifted inward and sutured.

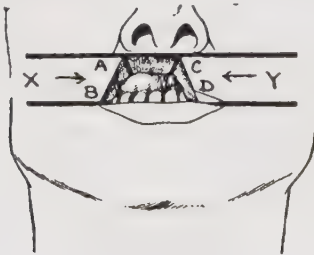


FIG. 564.

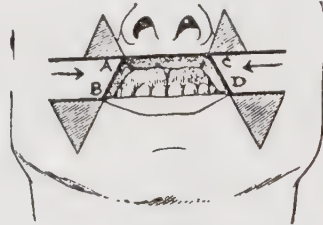
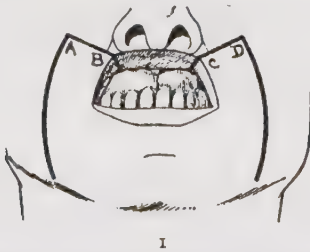


FIG. 565.

FIG. 564.—Operation for the reconstruction of the upper lip (*Lisfranc*).—The flaps X and Y, with pedicles lateral as outlined, are shifted inward and sutured in the midline, AB to CD.

FIG. 565.—Operation for the reconstruction of the upper lip (*Burow*).—The dark lines indicate the incisions for the lateral flaps. The shaded triangular areas indicate the slack normal tissue removed. The flaps are shifted inward and sutured in the midline, AB to CD.



1



2

FIG. 566.—Operation for the reconstruction of the upper lip (*Denonvilliers*).—1 and 2. The flaps are outlined and shifted downward and inward, AB being sutured to CD in the midline.

BILATERAL FLAPS WITH PEDICLE BELOW.—Denonvilliers (1854) constructed an upper lip, which was totally lacking, by using two

large vertical flaps through the full thickness of the cheek with pedicle below. The internal border of the flaps was continuous with the loss of substance, and the external with an incision just in front of the masseter muscle, and extending from the inferior border of the lower jaw to the level of the ala of the nose. A transverse cut joined the two



FIG. 567.—Operation for the reconstruction of the upper lip (modified from Nélaton and Ombrédanne).—1 and 2. The flaps are outlined as indicated and shifted downward and inward. The lines *AB* forming the border of the lip after the lines *BC* have been sutured in the midline.

The flaps were loosened and turned toward the midline where the upper borders were sutured. The inner margin of the flaps form the free border of the lip, and the mucous membrane is sutured to skin to form the vermilion line.

Nélaton and Ombrédanne utilize a flap from each cheek with the pedicle below, but with the lateral incision not extending below the level of the commissures. This operation is an improvement on that of Denonvilliers inasmuch as the commissures are not distorted. If the vermilion line is reconstructed, there is little tension on the flaps, the lip is of the proper height and well lined with mucosa.

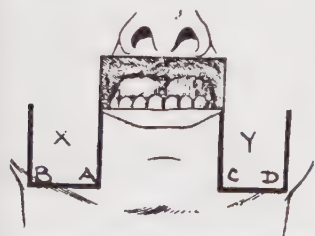


FIG. 568.—Operation for the reconstruction of the upper lip (Sédillot).—The flaps *X* and *Y*, with pedicles above, are raised and shifted upward and inward, the free ends *AB* and *CD* being sutured in the midline.

BILATERAL FLAPS WITH PEDICLES ABOVE. In Sédillot's operation a rectangular vertical flap is raised from each side with the pedicle above. Its base is on a level with the commissures, and is continuous with it on its inner border, the free end being at the lower margin of the mandible. These flaps are shifted upward and inward, the lower borders being united in the midline.

Szymanowski also used a flap with the pedicle above. The axis of the flap is downward and outward, and all the incisions are curved. The lower incision begins at the commissure, the upper at the level of the ala.

The deformity following these operations is much more marked than when the pedicle is below; moreover, the lower lip is likely to be much distorted.

Reconstruction of the upper lip has been attempted by using flaps from the forehead, but unless the under surface of the flap has been previously grafted, or has been folded on itself, the procedure is useless. This also holds for pedunculated flaps from the arm. If one of these methods is to be used my preference would be for the arm flap, but of course each case must be dealt with on its own merits. The Italian method, unless the flap has been previously lined, should not be used to reconstruct the upper lip.

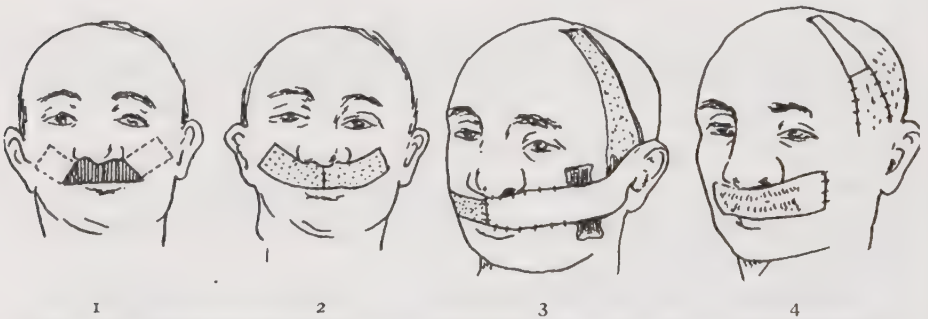


FIG. 569.—Method of forming an upper lip (Cole: by permission of the Editor of the *Practitioner*).—1. The outline of the hinged flaps with pedicles at the margin of the defect are indicated by the dotted lines. 2. The hinged flap turned in and sutured in the midline. 3. A flap from the scalp turned down and covering one-half of the lip. A flap from the other side of the scalp is used to cover the other half. 4. The result of the plastic operations. All defects should be closed by sutures, or grafted.

SECONDARY RECONSTRUCTION OF THE UPPER LIP

The utilization of the scar tissue which covers the surface of the defect is open to question, on account of poor circulation. Nevertheless, we are often tempted to use it, especially for lining a flap of skin brought in from elsewhere (the arm or forehead). I have had some success with tissue of this type, but a flap previously lined, or a flap of normal skin turned in to line the defect, is to be preferred, and in the end will give the best results.

Berger uses a single flap of sufficient width and length, with the pedicle below, to reconstruct the upper lip. It is slightly curved and has a square end which is on a level with the top of the defect, its pedicle being on a level with the commissure, and its inner border continuous with the defect. It includes the full thickness of the cheek and is

shifted downward and inward, the upper border being sutured to the freshened edge of the lip on the opposite side. The margin of the lip

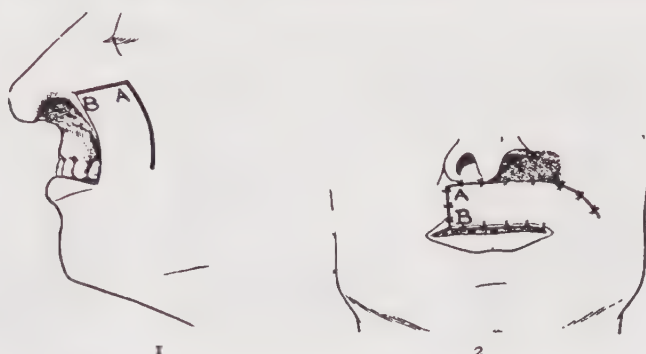


FIG. 570.—Operation for the reconstruction of the upper lip (*Berger*).—1. The outline of the cheek flap which is shifted downward and inward to fill the defect. 2. The flap in position.

is formed by the inner edge of the flap, and the mucous membrane lining is sutured to the skin to form the vermilion border (Fig. 570).

Gurdon Buck's Operation for the Reconstruction of the Upper Lip

by Using a Flap from the Lower Lip.—

He divides the extremity of the lower lip where it joins the cheek through its entire thickness at right angles to its border for 2.5 cm. (1 inch). From the end of this incision he makes another incision 3.75 cm. (1½ inches) parallel to the lip border and extending toward the chin. If necessary, he partially divides the base of this quadrilateral flap with an oblique incision which gives more freedom to the flap. The remaining portion of the upper lip is loosened and shifted toward the defect, and the vermilion edge of the half-lip is separated sufficiently to meet that of the flap from the lower lip. After the edges of the gap have been freshened, the flap is sutured into place. Subsequently it be-



FIG. 571.—Operation for reconstruction of the upper lip (*Buck*).—The dark lines indicate the incisions outlining the flap from the lower lip, the pedicle of which is at the point D. This flap is shifted upward to fill the defect in the upper lip, and is sutured to the freshened normal edges.

comes necessary to lengthen the commissure on that side (Fig. 571).

I was able in one instance to reconstruct the upper lip—in a case in which there was also ankylosis of the jaws and complete obliteration

of the buccal mucosa on that side—by employing the following procedure: the cheek was separated from the jaws on the right side and

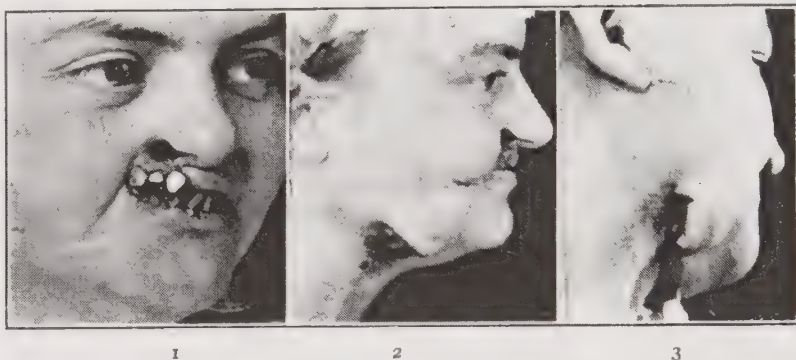


FIG. 572.—Restoration of the upper lip and lining the cheek, for a defect following noma. Duration twelve years.—1. Note the absence of the right side of the upper lip and ala. The upper teeth have been turned outward by scar contracture. The jaws are locked. 2 and 3. The result of turning up a pedunculated flap from the neck to line the cheek. Note the neck scar and the position of the pedicle.

was lined by using a pedunculated flap turned up from the neck. After the lining had become assured the vermilion border was detached from

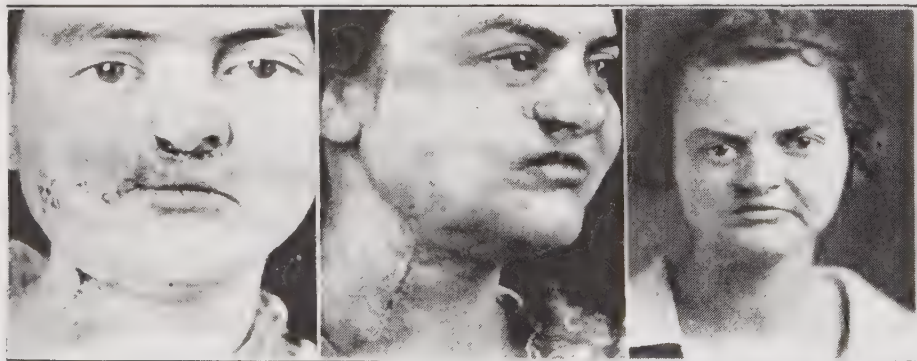


FIG. 573.—Restoration of the upper lip, *continued*.—1. After the lining of the cheek was assured the pedicle was cut and fitted into position. The upper lip was loosened on the left side and shifted toward the right. The lined cheek was shifted inward and the flaps were sutured, thus filling the defect. The vermilion border was formed with flaps from the upper and lower lips. Photograph taken ten days after the operation. 2. Shows the result of the repair of the ala by means of a flap from the cheek covering a flap turned down from the nose. 3. Five months after discharge from the hospital. Compare with the original condition. The jaws can be partially opened as the result of removal of the condyle on the right side. Secondary shaping operations will be necessary to complete this case.

the remaining portion of the lip on the other side, and then by means of a horizontal incision close to the nose the lip was loosened and shifted toward the defect. The lined portion of the cheek was then shifted

inward and sutured to the lip flap from the other side, and the vermilion border was completed by joining that on the upper to a flap obtained from the lower lip. The angle of the mouth was subsequently lengthened and the result was satisfactory, the lip being lined with mucous membrane and with a portion of the pedunculated flap which had been turned up from the neck to line the cheek. Subsequently the condyle was removed on that side, and motion of the jaw was improved (Figs. 572-573).

IMMEDIATE RECONSTRUCTION OF THE LOWER LIP

FRENCH METHOD.—This method ordinarily entails a considerable amount of tension on the line of sutures. Then, if any infection occurs—which is not an infrequent happening—we may have a fistula in the suture line, or a notch at the margin. In other cases the wound will



FIG. 574.

FIG. 575.

FIG. 574.—Closure of V-shaped defect.—1. A V-shaped excision of a growth in the midline has been made. 2. The edges have been closed in a vertical line. If the gap is wide the method is not to be advised, inasmuch as the tension may cause the stitches to tear out.

FIG. 575.—The W-shaped excision of Bouisson.—The growth has been excised by a W-shaped incision. The points A and C are joined and the wedge B is drawn up to complete the closure.

break down completely. Square flaps are more satisfactory than triangular flaps.

PARTIAL LOSS OF SUBSTANCE.—When we have a small V-shaped defect, the edges may be approximated and sutured. If the gap is wider, Nélaton and Ombrédanne's operation is advisable. A V-shaped area of tissue from the full thickness of the lip containing the growth is removed with a wide margin of normal tissue. This wedge of tissue extends down to the point of the jaw. Then one or two incisions (as may be necessary) are made parallel to and below the jaw extending as far out as the carotid artery, and through these incisions the glands are removed. The lip and neck wounds are then closed, drainage being provided for. Suture of the lip defect causes great constriction of the

mouth which, however, can be remedied by making an angled incision in the cheek on each side, and lengthening the commissures. Care must be taken to suture skin to mucosa everywhere (Fig. 576).

COMPLETE LOSS OF SUBSTANCE.—All flaps from the chin are without a lining of mucosa, and for this reason will subsequently contract.

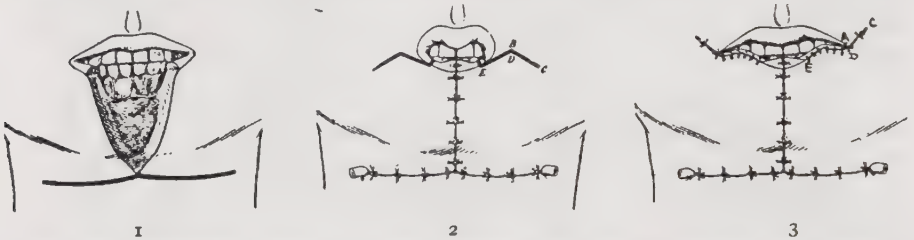


FIG. 576.—Operation for repair of lower lip (modified from Nélaton and Ombrédanne).—1. Shows extent of excision of lip. The dark line indicates the neck incision for removal of the glands. 2. Result of closure of lip defect showing constriction of mouth. 3. The line AB is sutured to the line BC. Along the line ED the buccal mucosa is sutured to the skin.

The single square flap as used by Chopart (1785) which is drawn upward vertically is undesirable because the subsequent cicatricial contraction usually draws down the newly formed lip and there is a median gutter through which the saliva runs. Some improvement on this method may be made by lining the lower lip with a pedunculated flap

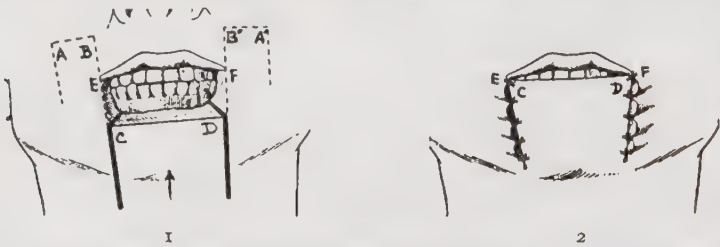


FIG. 577.—Chopart-Alquié's operation for the reconstruction of the lower lip with a square flap, pedicle inferior.—1 and 2. Two vertical incisions prolonging the sides of the loss of substance are made as far down the neck as necessary. The flap is loosened and lifted upward into the defect. This forms the lip without a lining. Alquié modified Chopart's operation by lining the lip with pedunculated flaps of mucous membrane ABC and A'B'D from each cheek.

of cheek mucosa from each side, which is sutured across the midline, as suggested by Alquié (1855). But this will not always counteract the tendency for the new lip to retract. A relaxation incision across the neck below the chin may be of advantage when this type of operation is chosen (Fig. 577).

The flap from below may have a split pedicle, one portion from each side of the midline, as in Zeiss' operation; or the flaps may be double, one from each side, as used by Szymanowski.

Bilateral flaps stretched transversely are even less desirable than the square flaps, because they are less mobile. They may be useful for the small losses of substance, but the advisability of utilizing this method for total restoration of the lower lip is questionable. In the

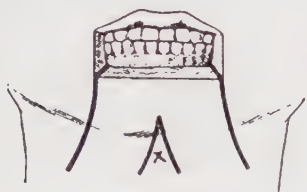


FIG. 578.

FIG. 578.—Operation for the reconstruction of the lower lip with double vertical flap pedicles below (*Zeiss*).—The dark lines indicate the outlines of the flaps which are shifted upward. The V-shaped area X below the flaps is used as a buttress. The newly formed lip is without an epithelial lining.

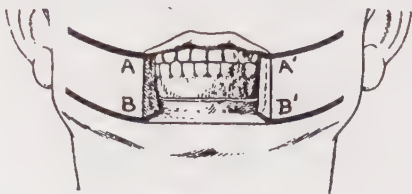


FIG. 579.

FIG. 579.—Operation for the reconstruction of the lower lip with lateral flaps, pedicle external (*Serre*).—The lower lip has been removed leaving a quadrangular defect. An incision on each side is made prolonging the commissures. Another incision is made parallel to the above, and on the level with the lower border of the defect. The flaps thus made through the full thickness of the cheeks are shifted inward and sutured in the midline A to A'.

operations of Lisfranc (1829), Malgaigne (1834), or Sédillot (1856) horizontal or slightly curved incisions are made from the angles outward as far as the masseter, and the flaps thus formed are drawn inward and sutured in the midline. To this group may be added the operation



FIG. 580.

FIG. 580.—Operation for the reconstruction of the lower lip (*Lisfranc*).—The dark lines indicate the incisions. The points A and B are approximated and the edges are sutured vertically in the midline.

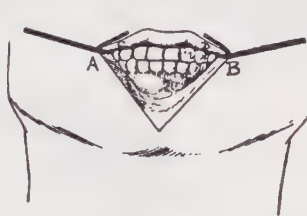


FIG. 581.

FIG. 581.—Operation for the reconstruction of the lower lip (*Sédillot*).—The dark lines indicate the incisions. The flaps are then shifted toward the midline and sutured vertically A to B. (Note the utilization of small flaps from the vermilion border of the upper lip on each side, C and D, to form a margin for the lower lip.)

of Pollosson, who uses an angled incision. Sédillot utilizes a flap of the vermilion border taken from the upper lip on each side.

In this group Dieffenbach and Desgranges (1853) utilize the vermilion border of the upper lip to surround the mouth, secondary operations being necessary to lengthen the commissures. The operation

C. Bernard leaves the upper lip much puckered, and excision of triangles of healthy skin at the angles, after the method of Burow, is used to correct this defect.

The operation of Nélaton and Ombrédanne, which was previously described when we spoke of partial loss of substance, is a much better

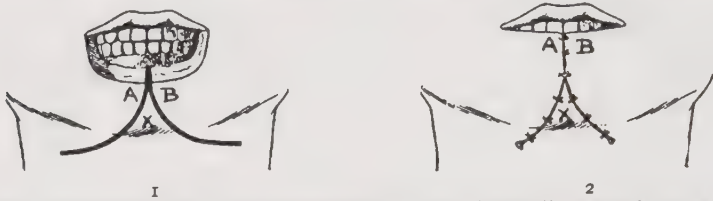


FIG. 582.—Operation for the reconstruction of the lower lip (*Beau*).—1 and 2. The dark lines indicate the incisions. The flaps A and B are shifted upward and sutured in the midline. They are buttressed on the point X.



FIG. 583.—Operation for the reconstruction of the lower lip (*Weber*).—1 and 2. The dark lines indicate the incisions outlining the flaps X and Y, which are raised and superimposed. The point B is sutured to the commissure at D, and the point E to the base of the flap X at C. The newly formed lip is without epithelial lining.



FIG. 584.—Combined operation for the reconstruction of the lower lip (*Serre*).—1. The dark lines indicate the incisions. The flap X is shifted upward. The vermilion line BC is shifted in the direction of the arrow and sutured to AN. The cheek flap MKH is undercut and shifted upward, K being sutured to A. The flap X is then shifted upward, the edge EL being sutured to DN. 2. The dark lines indicate the incisions. The flap Y is shifted upward, NK being sutured to FH. The flap X is shifted outward, the line AB being sutured at the line EO.

procedure for widening the mouth, and by its use the sacrifice of the triangles of skin is avoided.

Flaps stretched obliquely are also less mobile than square flaps, and are even less desirable than the flap with its pedicle transverse,

as the lower border of the new lip soon retracts. These flaps may be unilateral (Roux, 1828, and Szymanowski) with pedicle below and oblique, or bilateral (Beau, 1869, and Weber) with pedicles below and oblique. In these flaps there is, of course, no mucous lining, so that they soon contract.



FIG. 585.—Operation for the reconstruction of the lower lip with lateral flaps, pedicles below (*Dieffenbach*).—1 and 2. The outlines of the flaps through the full thickness of the cheek are indicated by the dark lines. They are shifted inward and sutured A to B in the midline. The defects left in the cheeks are filled by shifting in neighboring soft parts,

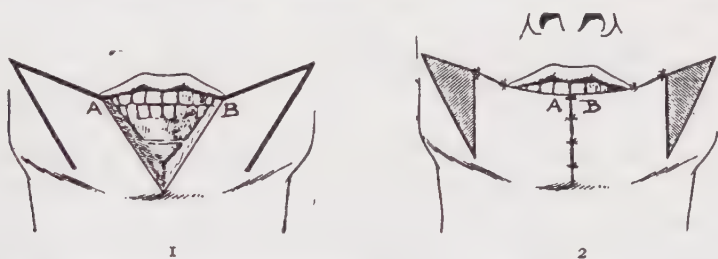


FIG. 586.—Operation for the reconstruction of the lower lip with lateral flaps, pedicle below (*Adelmann*).—1 and 2. The dark lines indicate the incisions which penetrate to the mucosa. The flaps are shifted inward and are sutured in the midline. The cheek defect are narrowed by drawing in the surrounding soft parts. The lip thus formed is not lined with epithelium.



FIG. 587.—Operation for the reconstruction of the lower lip with lateral flaps, pedicle below (*Jäsche*).—1 and 2. The curved dark lines indicate the incisions through the full thickness of the cheeks. These are shifted inward and sutured in the midline, A to B.

Erichsen excises triangles of normal tissue at the angles, and in the midline below, but when the wounds are closed there is constriction of the buccal orifice together with a considerable amount of scarring.

All of the operations by the French method in which bilateral flap

are used are designed to reconstruct symmetrical lesions of the lip, exactly similar procedures being carried out on each side. When the lesion is not symmetrical some combined method, such as that suggested by Serre in which a lateral flap and a flap from below are shifted, may be advantageous, although the result may not be a cosmetic success.

INDIAN METHOD. FLAPS FROM THE CHEEK AND CHIN.—The pedicles may be below, as typified by Dieffenbach's operation in which a

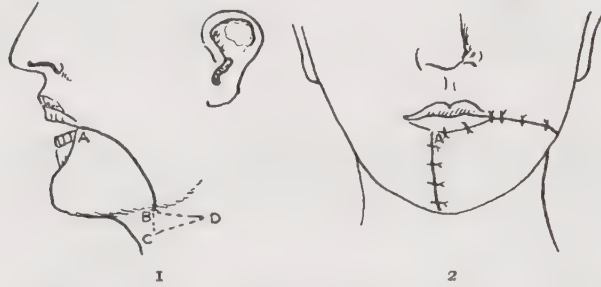


FIG. 588.—Operation for reconstruction of the lower lip (*Heurtaux*).—1. The dark line indicates the incision. The dotted lines show the area of redundant tissue which should be excised when the flap is in position. 2. Shows the flap sutured into the defect.

flap through the full thickness of the cheek is shifted in from each side and sutured in the midline. Adelman's operation is much like that of Dieffenbach's except that the flaps are much more extensive, the external border being on the masseter muscle, and the incisions do not go through the mucosa. Nélaton and Ombrédanne have also modified Dieffenbach's operation. In Jäsche's operation the incisions are curved



FIG. 589.—Operation for the reconstruction of the lower lip with lateral flaps, pedicles below (*Reid*).—1 and 2. The dark lines indicate the outlines of the flaps through the full thickness of the cheeks. They are shifted inward and sutured in the midline, A to B.

and pass from the commissures outward and slightly upward, and then downward, parallel to the borders of the defect, as far as necessary on the neck. The full thickness of the cheek is included. Heurtaux (1893) makes a similar curved incision, but uses only one flap. In order to prevent puckering of the skin on the convex side of the curve he excises a triangular-shaped piece of skin. The excision of the skin

may be obviated by making the original incision curve backward so that the entire cut has an S-shape.

In Ried's operation the incisions are curved much the same as in Jäsche's, but when the lower jaw is reached they are brought back parallel to it toward the chin.

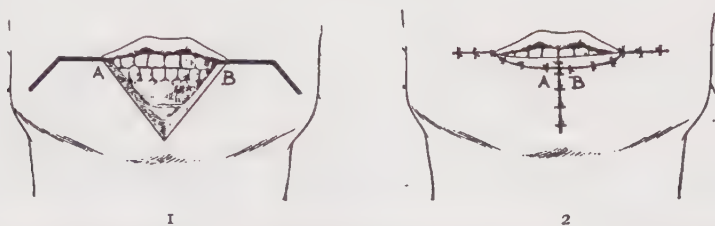


FIG. 590.—Operation for the reconstruction of the lower lip with lateral flaps (*Polloson*).—1 and 2. The dark lines indicate the incisions through the cheeks. The lateral flaps are shifted inward and are sutured in the midline, A to B. The mucosa is brought forward and sutured to the skin to form the vermilion border.

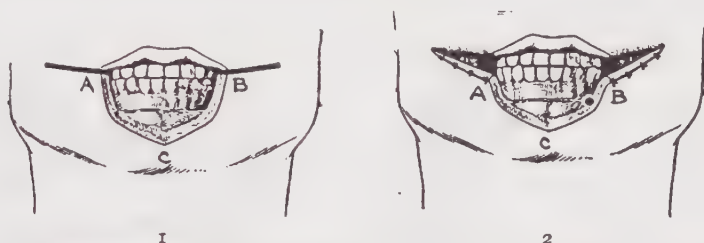


FIG. 591.—Operation for the reconstruction of the lower lip with lateral flaps (*Berger*).—1 and 2. Incisions continuous with the commissures are made on each side and the mucous membrane and skin are sutured together.



FIG. 592.—Operation for the reconstruction of the lower lip with lateral flaps, *continued*.—1 and 2. Several weeks later flaps are made as indicated by the dark lines, and shifted toward the midline, where they are sutured, AC to BC.

Berger performs Dieffenbach's operation in two stages. This is much safer, although it takes longer to secure a result. He makes a horizontal incision from each corner of the mouth extending the desired distance. This penetrates all the tissues down to the mucosa, which is divided 1. cm. ($\frac{2}{5}$ inch) above the skin incision. The flap of mucosa is turned out and sutured to the skin on the lower side, and will even

tually form the vermillion border of the new lip. The skin and mucosa are sutured together in all places where this is possible. This procedure makes an opening twice the length of the normal mouth. After several weeks the scar tissue is removed from the edges of the lip defect and along the upper border of the cheek incision. Lateral incisions are made on each side from the corners of the mouth downward, and parallel to the borders of the lip defect, and the flaps thus made, including the full thickness of the cheek, are shifted toward the midline. Sutures are inserted and the lip and mouth reconstructed. The lateral openings left by shifting the flaps are filled by undercutting and shifting in the soft parts. A similar procedure may be used on one side only if the defect is unilateral.

Nélaton and Ombredanne's Operation for Extensive Loss of Substance of the Lower Lip.—The defect is first made triangular in shape. A vertical incision is made on the neck from the apex of the triangle.

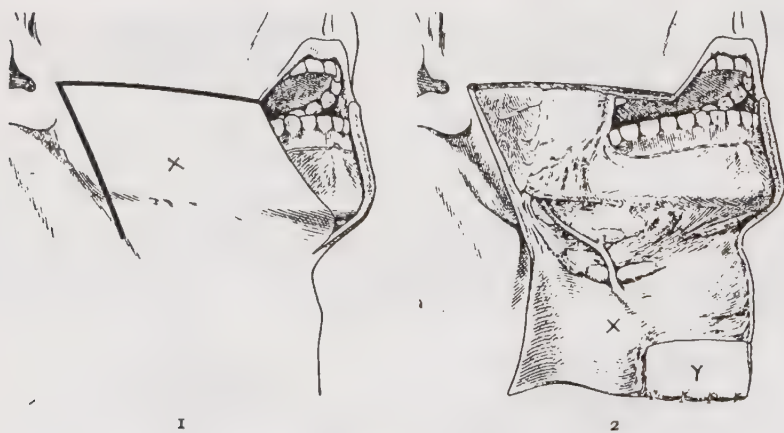


FIG. 593.—Operation for the reconstruction of the lower lip in extensive defects (modified from Nélaton and Ombredanne).—1 and 2. The dark line indicates the incision made on each side of the defect to form the flap X.

From the angles of the mouth incisions are made through the skin only, so just below the tragus, and then from this point parallel to the border of the defect downward below the lower edge of the mandible. The mucous membrane is then divided on the cheek 0.8 cm. (about $\frac{1}{3}$ inch) above the skin incision, and in reflecting the flap downward the operator also divides it along the anterior border of the masseter. Mucous membrane is sutured to skin to form a new vermillion border. The flaps are reflected, care being taken not to disturb the parotid gland or the facial artery. After excision of the glands the lower

mucous border is sutured to the mucosa of the lower jaw, and the flaps are raised and the necessary sutures are inserted, thus closing the lip defect. This is certainly an effective procedure but is quite radical, and should be undertaken only in exceptional cases (Figs. 593-594).

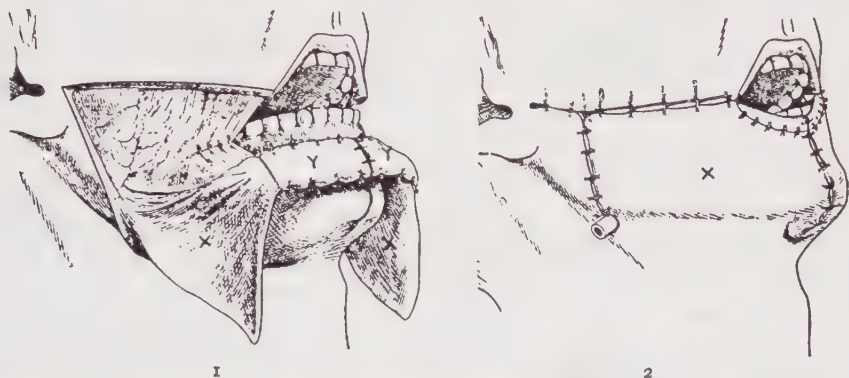


FIG. 594.—Operation for the reconstruction of the lower lip in extensive defects, *continued*.—1. The flap X turned back. Y indicates the lining of the lower lip formed from the mucous membrane of the cheek. 2. The flaps sutured in position, and the lip formed.

FLAPS WITH LATERAL PEDICLES.—These flaps are easy to obtain and apparently fill the defect nicely, but unless they are lined little can be accomplished. It is best to employ a lining flap first, obtained from the situation most favorable, and then cover the raw surface with the lateral flap.



FIG. 595.—Operation for the reconstruction of the lower lip (*Anger*).—1 and 2. The dark lines indicate the incisions made to form the flap which is raised from the chin and neck. It is shifted upward to fill the defect. The lip is not lined with epithelium.

The defect from which the flap is raised can usually be closed by undercutting and shifting neighboring skin; when this is not possible the raw surface should be grafted. The use of lateral flaps without lining cannot be recommended, but as this type of flap may be used in combination with others, I shall mention some of the methods.

The flaps are raised from the skin of the chin or neck, and may be

unilateral or bilateral. Anger (1877) utilizes a unilateral quadrangular flap from the skin of the neck and chin to repair a total absence of the lower lip. For a less extensive defect Ledran shifts up a flap from the chin. Berg does a very similar operation.

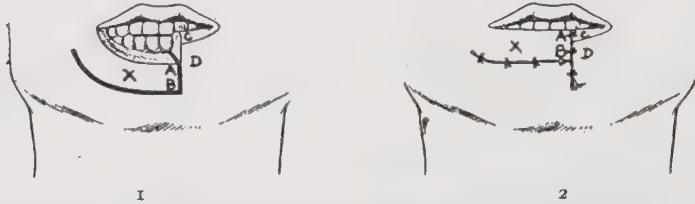


FIG. 596.—Operation for the reconstruction of the lower lip (*Ledran*).—1 and 2. The flap X is outlined by dark lines. It is shifted upward, the line AB being sutured to CD.



FIG. 597.—Operation for the reconstruction of the lower lip (*Berg*).—1 and 2. The flap is indicated by dark lines. This flap is raised and shifted to cover the defect, the point B forming the commissure at D.

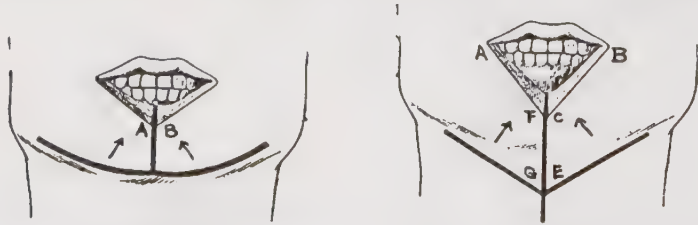


FIG. 598.

FIG. 598.—Operations for the reconstruction of the lower lip (*Dieu-Lafoy*).—The flaps are outlined by the dark lines. They are shifted upward and sutured in the midline, the points A and B meeting at the lip margin.

FIG. 599.—Operation for the reconstruction of the lower lip (*Auvert*).—The dark lines indicate the incisions. The flaps are shifted upward and sutured in the midline, the points F and C meeting in the midline of the margin of the lip.

BILATERAL FLAPS.—Dieu-Lafoy uses a double flap for repairing a wide but comparatively shallow loss of substance. He makes a midline vertical incision to the inferior border of the mandible, and then two lateral incisions of the desired length along the inferior border of the lower jaw. Auvert, for more extensive defects, uses much larger flaps. He makes a median incision down to the thyroid cartilage, and

lateral incisions in the skin of the neck. The flaps are loosened and shifted upward.

FLAPS WITH A DOUBLE PEDICLE.—This method has been used by Viguerie-Morgan, Wölfler, Mazzoni, and others. A bridge flap is made by means of a horseshoe or widely spread V-shaped incision, parallel to the border of the inferior maxilla, and extending as far on each side



FIG. 600.—Operation for the reconstruction of the lower lip (*Viguerie-Morgan*).—The double pedicled flap is outlined by the dark lines. It is shifted upward forming the lower lip.

as may be necessary. The commissures are lengthened by horizontal incisions parallel to the above. The flap thus marked out is separated from the underlying tissues and shifted upward to cover the defect. Redundant tissue will be found at the commissures and should be removed in the way best suited to the case. Sandelin uses the bridge flap, and in addition to sutures holds it in position by means of a tack (I have found this useful and have employed a wire

staple) driven through the flap into the mental process of the mandible. He then covers the upper border with a double-pedicled flap of mucosa from the upper lip, after the method of Schulten, which will be described later.

FLAPS WITH PEDICLES ABOVE.—When extensive defects of the lower lip are closed by flaps with pedicles above, these must be bilateral

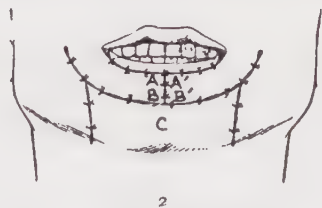
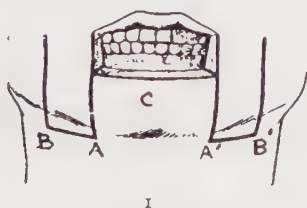


FIG. 601.—Operation for the reconstruction of the lower lip (*Sédillot*).—1 and 2. The lateral flaps with pedicles above are indicated by the dark lines. They are raised and turned upward and inward, the extremities AB and A'B' being sutured together in the midline. The square area C on the chin supports the flaps.

This method has been used by several surgeons, and the operation of Sédillot (1848) may be taken as a type. He raises from each side a flap of sufficient width and extending from the level of the commissure vertically downward as far as necessary on the neck. The flaps are turned upward and inward, and are sutured in the midline and across the base. Sédillot did not at first utilize the mucous membrane lining the upper portion of the flap, but Bouisson attempted to line the li-

with it, and later Sédillot used a portion of the vermilion border of the upper lip from each end to cover the commissures and a part of the margin of the new lip.

Nélaton and Ombrédanne employ a curved flap from each side, utilizing the buccal mucosa on the flap, and also a portion of the vermilion line of the upper lip to complete the border of the new lip. This

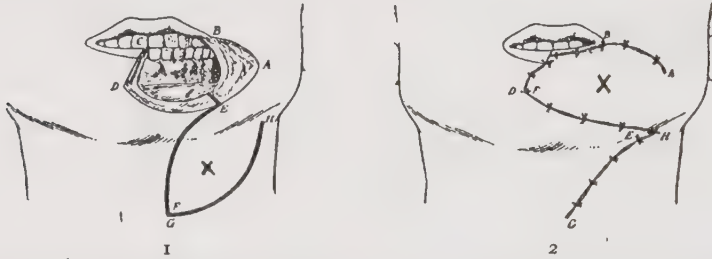


FIG. 602.—Operation for the reconstruction of the lower lip (*Lallemand*).—The dark lines indicate the incisions outlining the flap X. It is raised and shifted upward into the defect, the point F meeting the point D.

method is not a desirable one because the mucous lining of the lip is lacking over a considerable portion, the commissures are distorted, and secondary operations become necessary. In addition, the upper border of the lip will often become everted.

BUTTRESSED FLAPS.—Jumping a flap from the chin or neck over intervening skin and underlying tissues on the chin, whose attachments

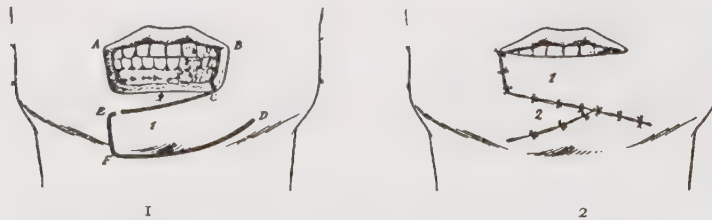


FIG. 603.—Operation for the reconstruction of the lower lip (*Langenbeck*).—1 and 2. The flap 1 is superimposed and buttressed on the area 2, which is not detached from the chin.

are undisturbed, is an old method and, as far as support is concerned, presents a good deal of advantage over other procedures in which lateral attachments and sutures are mainly depended upon for support. The flaps may be unilateral or bilateral. Lallemand (1824) obtained a single flap of suitable size and shape from the neck below the defect, jumped it over the undisturbed tissues on the chin, and sutured it into the defect.

Langenbeck employs a single flap from the chin just below the defect.

Landreau uses a half-curved single flap of sufficient length and width from the chin and cheek with its pedicle lateral, and level with the commissure on one side. The flexibility of the tissues allows the flap to

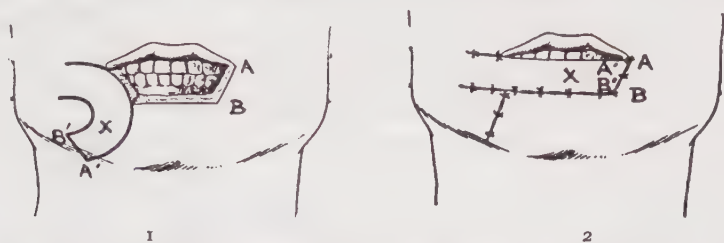


FIG. 604.—Operation for the reconstruction of the lower lip (Landreau).—1 and 2. The curved flap X is raised and shifted into the defect, A'B' being sutured to AB.

be straightened and sutured into position, resting on the undisturbed tissues of the chin (Figs. 603–604).

Trélat's operation (1861) may be taken as a type of the use of bilateral flaps. A quadrilateral flap is raised from each side of the

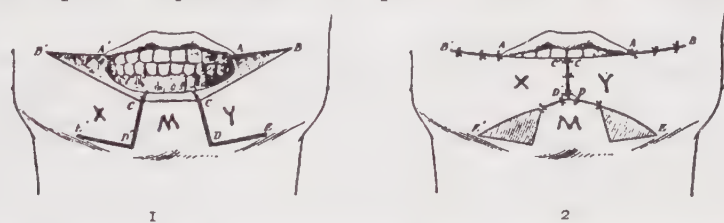


FIG. 605.—Operation for the reconstruction of the lower lip (Trélat).—1 and 2. The flaps X and Y are raised and sutured in the midline, CD to C'D'. They are buttressed on the area M.

chin leaving a square broad area undisturbed on the point of the chin. Triangles of excess tissue down to the mucosa are removed from the corners of the mouth. The flaps are loosened and shifted upward and



FIG. 606.—Buchanan-Syme's operation for the reconstruction of the lower lip.—1 and 2. The dark lines indicate the incisions. The flaps are shifted upward and sutured in the midline, HM to LN. They are buttressed on C.

sutured in the midline and to the undisturbed area on the chin. This will leave two uncovered surfaces on each side of the chin which may be sutured or else grafted. This seems to me a better operation than

that of Blasius' or Buchanan-Syme's, because the buttress on the chin, being square instead of pointed, gives better support. Blasius used curved incisions and in Buchanan-Syme's operation the incisions are angular. Dowd's operation is very similar to that of Buchanan-Syme, but an additional incision is made through the cheek, extending from the commissures outward in order to mobilize the flaps more completely (Figs. 605-607).

DOUBLE-PEDICLED FLAPS.—Ollier uses a curved bridge flap with pedicles on each cheek, according to the method of Viguerie-Morgan, but instead of shifting up all the chin tissue a central buttress is left, and the bridge flap is jumped over it and sutured into position. This is an improvement on Viguerie-Morgan's operation. Morestin and J. F. Baldwin use a similar method, but line the lip with a flap of scar tissue before shifting the double-pedicled flap upward.

Grant's Operation.—A quadrangular excision is made. Then from the inferior angle of the wound on each side an incision is carried obliquely downward and backward across the mandible, on a line about equidistant between the angle and the symphysis. Through these incisions, which are lengthened

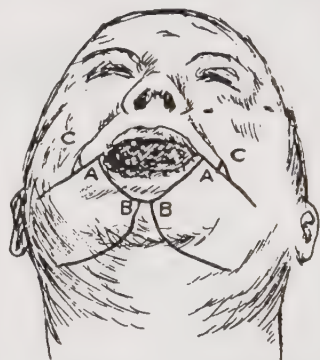


FIG. 607.—Operation for restoring the lower lip (Dowd).—The dark lines indicate the incisions made in the removal of the growth (entire lower lip) and for the formation of the flaps. The lateral flaps are through the full thickness of the cheek and when united the point A is sutured to A', and B to B'. The mucous membrane is divided slightly higher than the skin in making the flap, thus providing a vermillion border when it is sutured to the skin. CC indicate wedges of slack tissue to be removed.

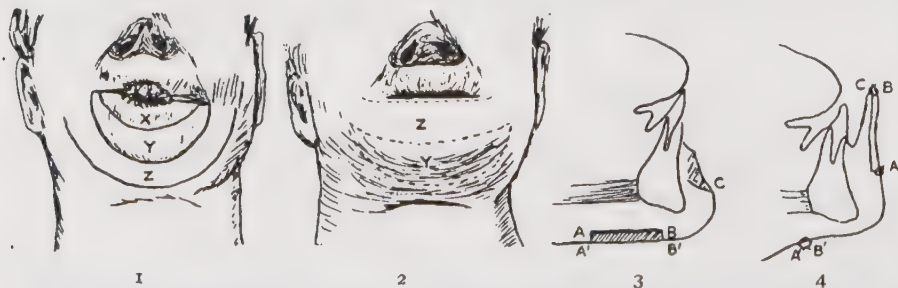


FIG. 608.—Cheiloplasty (Morestin).—1. The dark lines indicate the incisions. The flap of scar X with pedicle above, which is turned up to line the lip. The buttress flap, Y. The double pedicled flap Z which is raised. 2. Shows the flap Z raised and placed above the buttress Y. 3. Diagrammatic midline section. The flap AB corresponds to the flap Z. The flap C corresponds to the flap X. 4. The flaps in position.

as needed, the submaxillary glands are removed, a separate incision being required for the submental gland. The edges of the cheek flaps

are then sutured in the midline, and are fixed and supported by the buttress on the chin. Tension sutures may be necessary, and the angles of the mouth may have to be lengthened (Fig. 609).

FLAPS FROM THE UPPER LIP may be unilateral or bilateral, according to the width of the defect. They have the advantage of being lined with mucosa and the utilization of a portion of the red border of

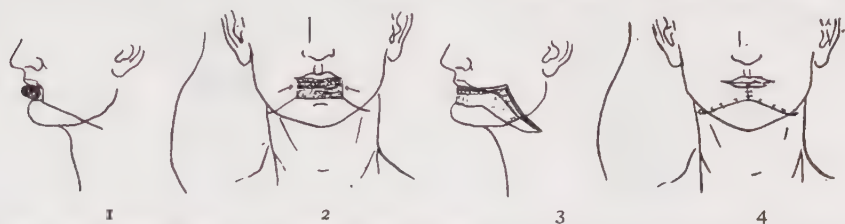


FIG. 609.—Operation for restoring the lower lip (*Grant*).—1 and 2. The dark line indicate incisions made in removal of growth on the lip, and for the plastic repair. 3 Shows retraction of the tissues after the incisions are made. The tissues on the chin are not disturbed. 4. Shows the wound closed. This operation is a good one and has the advantage of a buttress on the chin.

the upper lip near the angles insures a satisfactory commissure. These flaps seldom evert, and good results are usually obtained.

Larger's Operation (1894).—An incision is made through the full thickness of the upper lip at the junction of the outer and middle thirds. This is extended upward and outward toward the ala, to the naso-labial fold. Joining this a second incision is made parallel to this



FIG. 610.—Operation for the reconstruction of the upper lip (*Larger*).—1 and 2. The flap outlined by the dark lines on the upper lip is shifted downward and, after removal of the portion of the vermilion border, is sutured into the defect AB to CD.

fold and extending downward to a point below the level of the commissure. The portion of the vermilion border which is attached to the lower border of this flap is removed. The flap is shifted downward and sutured into position, and skin and mucous membrane are united wherever possible. The cheek wound is then closed. In this operation the outer third of the vermilion line of the upper lip is destroyed. Guinard utilizes this mucous membrane in the formation of the gingiva.

labial groove, which is an improvement, and Morestin has employed this portion of the vermilion line (leaving it attached to the upper lip) in forming the commissure and outer portion of the border of the newly formed lower lip. I have obtained excellent results with this method (Fig. 610).

Estlander used a single flap running upward and outward across the naso-labial fold, with its base at the junction of the outer and middle



FIG. 611.—Operation for the reconstruction of the lower lip (*Estlander*).—1 and 2. The flap X, from the upper lip and chin, is turned and shifted downward into the defect. The free end A is sutured into the defect at B.

third of the upper lip. The scarring is more noticeable, the flap has to be twisted 180° on its pedicle, which is quite narrow and the blood supply is doubtful. In my opinion this procedure is not to be compared with the modifications of Larger's operation (Fig. 611).

The bilateral flap of von Bruns gives almost a double Larger's operation. The flaps do not encroach so much upon the upper lip, the



FIG. 612.—Operation for the reconstruction of the lower lip (*Bruns*).—1 and 2. The flaps from the upper lip are outlined by the dark lines. They are shifted downward to fill the defect, AB being sutured to CD in the midline.

inner border being in the naso-labial fold. As the best operation I would suggest a modification between the two methods to suit the individual case (Fig. 612).

FLAPS FROM THE SKIN OF THE NECK as originally employed are not to be advocated. Delpesch (1823) and many others, used an oval flap with its pedicle just below the chin and extending to the sternal notch. Its width should be sufficient to fill the defect, and it should be long

enough for its free end to be reflected on itself to line the lip. Then the flap is twisted 180° and sutured into the defect. Voisin (1835) used a triangular flap with its base above, and did not attempt to line it (Figs. 613-614).

Flaps have also been raised with a lateral pedicle, but without much success, as retraction usually takes place. My experience with

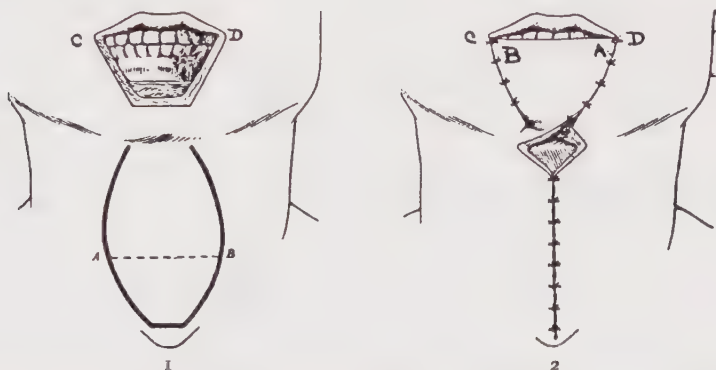


FIG. 613.—Operation for the reconstruction of the lower lip (*Delpech*).—1 and 2. The flap as outlined is raised from the neck and is folded on itself at the line AB. The pedicle is then twisted, the points A and D and B and C being brought together.

neck flaps has not been entirely unfavorable, in fact at times neck flaps may be used to great advantage. A neck flap with its base above may be turned up without twisting to line the lip when mucosa cannot be obtained, and its surface be covered with a flap, or flaps, from



FIG. 614.—Operation for the reconstruction of the lower lip (*Voisin*).—1 and 2. The flap as outlined is raised from the neck and, after twisting the pedicle, is sutured into the defect, the points A and D, and B and C, being brought together. This flap is not lined

elsewhere. In due time the pedicle is cut, the chin is shaped, and any fistulous tracts are attended to. The free end may be reflected on itself and allowed to heal before shifting. The under surface of the flap may be grafted either by the open or by the buried method, and the

after being twisted may be sutured into the defect. These procedures, of course, require preliminary preparation if they are used immediately to fill an operative defect.

Mauclaire constructed a lower lip and also replaced the skin below (which had been removed at operation), by using a flap whose pedicle was below on the neck at the side of the defect. The body of the flap extended up over the sterno-mastoid muscle, and its free end was on the mastoid process, so that the portion which was to form the lower lip was covered with hair. This operation is defective, inasmuch as there is no lining provided for the lip, and when it is used the under surface of the free end of the flap should be grafted previously, in order to furnish a lining.

ITALIAN METHOD.—There is little to be gained from the use of a flap from the arm in the immediate restoration of a lower lip unless this flap has been previously prepared by folding the end on itself, or grafting the under surface to form a lining. If either of these procedures are carried out, the double epithelial-lined flap may be successfully implanted and later shaped as desired. The arm flap may be also used to cover the

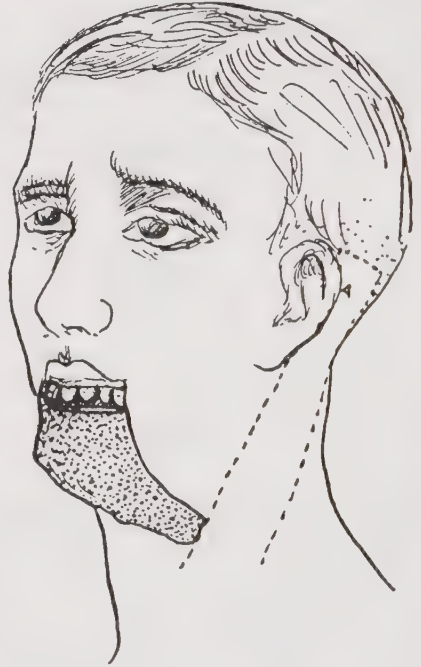


FIG. 615.—Operation for the restoration of the lower lip and skin below it. (Mauclaire).—The dotted area indicates the defect. The dotted line indicates the outline of the flap A, from the mastoid region with pedicle below, which is shifted forward to form the lip.

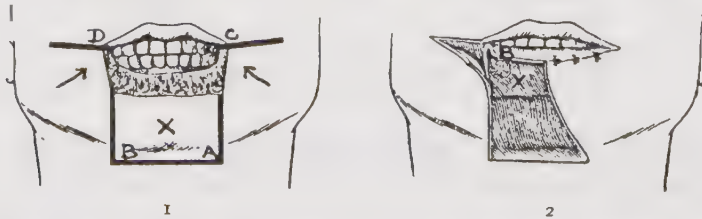


FIG. 616.—Operation for the reconstruction of the lower lip (Polaillon).—1. The flap X is turned up to line the lip, A being sutured to C, and B to D. 2. Lateral flaps are shifted in from the cheeks and sutured in the midline to form the external surface of the lip.

raw surface of a flap which has been turned up from the neck to line the lip. Watts reports a very satisfactory result in constructing a

lower lip with a flap from the arm, the raw surface of which had been grafted and healed before the transfer of the flap.

I can see no reason why this, or the folding method, should not be used more frequently. The scarring is less and the results are good.



FIG. 617.—Operation for the reconstruction of the lower lip (*Berger*).—1. The dotted line indicates the incision made to turn back a flap of scar to line the lip. 2. The flap turned up.

SECONDARY RESTORATION OF THE LOWER LIP

The restoration of the lip in old losses of substance, in which healing has taken place, brings in the problem of dealing with tissues which are more or less infiltrated with scar. Polaillon excised the scar and used



FIG. 618.—Operation for the reconstruction of the lower lip, *continued* (*Berger*, after *Nelaton* and *Ombrédanne*).—A pedunculated flap from the arm covering the raw surface. Note the apparatus holding the arm in position.

a flap of normal skin from the chin with its pedicle above at the edge of the defect. This flap was turned up and used to line the lip, and later flaps from the cheek were shifted in to cover it.

In defects of this character one may utilize the scar tissue to lin

the lip. This was first carried out by Berger. He dissected up a flap of the scar with its base above and turned it upward to line the lip. A pedunculated flap from the arm was then used to cover the raw surface.

The use of scar tissue to line the lip is a doubtful procedure because, in order to insure circulation, it must be cut so thick that a rigid flap is formed which is difficult to handle. One is nearly always tempted to try this method as it is apparently so simple, but here also the rule applies that scar tissue flaps are inadvisable whenever normal tissue is available. In addition the liability to infection around the mouth makes the successful use of this poorly nourished tissue largely a matter of chance.



FIG. 619.—Restoration of the lower lip for a defect following X-ray treatment.—1, 2 and 3. Condition of the patient when she came under my care, following intensive X-ray treatment. The entire lip is destroyed with the exception of a small tag of vermilion border, which can be seen in 3. The chin and adjacent portions of the cheek are covered with dense scar tissue. The lower teeth are on a bridge.

On the whole it is better, whenever possible, to excise the scar tissue and to shift in normal tissue. In certain extensive burns involving the face and neck, there is no normal tissue available from the immediate neighborhood, and for these the Italian method should be used. It has been said that the lip has little function when the defect is closed by the Italian method, but although this is true to a certain extent, I have found that if the edges are carefully freed from scar and the ends of the muscles of lip and cheek are sutured to the double faced flap, the function of the lip will be satisfactory.

The following history with operative notes will explain a method by which I was able to reconstruct a lower lip.

The patient who was 30 years old, had been treated over zealously

with x-rays for angioma of the lip. About 150 treatments had been given and the result was satisfactory so far as removing the angioma



FIG. 620.—Restoration of the lower lip, *continued*.—1, 2 and 3. Taken seven months after removal of the greater portion of the scar tissue and shifting up a double-pedicle flap from the skin of the neck. Compare with Fig. 619. Note the difference in the tissue covering the chin. In 3 can be seen the remains of an angioma on the left cheek.

was concerned, but unfortunately at the same time the greater portion of the lower lip and the adjacent soft parts of the chin and cheek had been destroyed. Several operations under general and local anesthesia



FIG. 621.—Restoration of the lower lip, *continued*.—1, 2 and 3. One month later. The lip was lined (over the bridge) with material from each side and the flap from the chin was shifted up to cover it. The vermillion border was formed by splitting the patch previously mentioned, and suturing it to the border of the newly formed lip. The defect of the chin was covered with another double-pedicle flap from the neck. Note the small amount of scar tissue remaining and the inconspicuous scars on the neck. Partial excision of the angioma of the left cheek has also been done.

had been done (pedunculated flaps from the arm, etc.) before the patient came under my care. The condition on admission was as follows:

The lower lip except for a tag of the vermillion border on the left side near the angle, was missing. The entire chin and neighboring portions of the cheek, especially on the left side, were covered with scar tissue. In talking or eating saliva constantly drooled out of the defect, and the patient was compelled to plug the space with a dressing to prevent this inconvenience.

The lower teeth, which had also been destroyed, had been replaced by a bridge with very long incisors and canines, as can be seen in the plates.

FIRST OPERATION.—The problem was to replace the scar tissue on the chin and cheek with normal skin before attempting the reconstruc-



FIG. 622.—Restoration of the lower lip, *continued*.—1, 2 and 3. Four months after construction of the lip. Note the shape of the chin and lip. The angioma has also been completely removed during this time. Several secondary shaping operations had been done. The result of the operations was the relief of a hideous deformity and the control of the constant drooling. This patient had been operated on a number of times before coming under my care and refused to consider the use of a pedunculated flap from a distant part, as this had been tried several times without success.

ion. The scar was dissected up from the chin with its pedicle at the margin of the defect, and sutured into position, skin side inward, in order to gain as much as possible from its use. The lateral areas of scar were then removed from the cheek and a double-pedicled bridge flap was dissected up from below the chin and shifted upward to cover the chin and adjacent raw areas. This flap covered the base of the scar issue flap without difficulty, and was sutured into position. The defect below the chin was made quite small by undercutting and sliding up the neck skin. In due time the greater portion of the scar flap sloughed, but the bridge flap lived and the chin was covered with thick skin and subcutaneous tissue. The defect was thus considerably reduced in size.

The patient was then sent home with instructions to massage the tissues, and after six months, when she returned for further treatment the skin and scar had been thoroughly loosened and were movable everywhere. The defect was more shallow and the chin and greater portion of the cheek areas previously covered with scar were now covered with soft movable skin, and in every way conditions for the reconstruction of the lip were more favorable than before.

SECOND OPERATION.—The tag of mucous membrane on the left side was split from the commissure toward the midline, but not completely through, so that when it was shifted with the flap of tissue outside of it, it unfolded and the outer portion with the skin was turned inward, and meeting a much shorter flap from the other side, formed the lining of the lip. This was bordered by the vermilion edge which nearly reached across the lip. The bridge flap of skin previously placed on the chin was then loosened and after excision of the scar in the angles was shifted upward well above the line of the lower teeth, to cover the lining flaps. There was no tension, but the flap was held in position with buried sutures of catgut, so placed as to give it support, and the mucous flap was sutured to the skin along the lip border. The defect below was then covered with a double-pedicled flap from the neck which was shifted upward and sutured to the lower border of the upper flap, and to the point of the chin. By undercutting down to the clavicle on each side, the skin of the neck was shifted upward and the defects were closed. Protective drains were placed in the lower angle. All wounds healed *per primam*.

Several shaping operations were subsequently done. The scars on the neck and face are quite inconspicuous, and in comparison with the original condition there is marked improvement.

This case shows the advantage of preparing the surrounding tissue before undertaking the reconstructive work. As a rule, there is marked shrinkage of the double-pedicled flaps shifted up from the neck, but in this case by first shifting the flap to cover the chin, and allowing it to contract in that position, there was little additional shrinkage when it was moved upward to form the outside of the lip. The color of the flap matches very well the skin of the face and on the whole the cosmetic and functional result is good.

LESIONS OF BOTH LIPS

EXTENSIVE LOSS OF SUBSTANCE.—Where there is a defect involving both lips at the same time, it is probably better to construct each

lip separately. However, several methods have been used for making the repair simultaneously.

Montet uses quadrangular flaps from the cheek and chin. The inner border of each flap is formed by the defect itself, and the free ends by incisions continuous with the upper and lower margins, the outer borders by incisions parallel to the edge of the defect. The pedicles of both flaps are together in the mid-portion of the cheek. The flaps are loosened so that the inner borders form the free margin of the lip, and the free ends of the flaps are sutured to the freshened edges of the upper and lower lips.

Mackensie shifts a broad flap from the chin and neck with a lateral pedicle. The flap is divided lengthwise and shifted upward, the upper

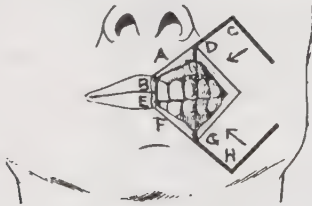


FIG. 623.

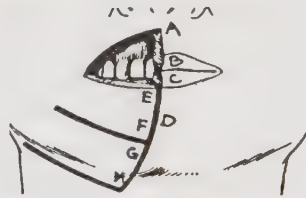


FIG. 624.

FIG. 623.—Operation for the reconstruction of both lips at the same time (*Montet*).—The flaps are raised as outlined. The upper flap is shifted downward and inward, the line CD being sutured to AB. The lower flap is shifted upward and inward, the line EF being sutured to GH.

FIG. 624.—Operation for the reconstruction of both lips at the same time (*Mackensie*).—The upper half of the flap is shifted upward so that the line EF may be sutured to AB to form the upper lip. The lower half is shifted upward, GH being sutured to CD to form the lower lip.

portion being sutured to repair the defect in the upper lip, and the lower portion to fill the defect in the lower lip.

Both of these operations are undesirable on account of scars and lack of sufficient mucous lining, but the principles may be useful and should be borne in mind.

Payan (1839) glides forward the cheek to form both lips at the same time, and makes the incision which is to form the mouth before sliding the cheek forward. Morestin uses a similar procedure but makes his incision secondarily after the cheek has been shifted forward.

RECONSTRUCTION OF THE VERMILION BORDER

Partial Destruction.—Defects in the vermilion border may be quite unsightly and call for operative interference. A simple method is to make an incision of sufficient length through the lip parallel to, and

0.2 cm. ($\frac{1}{12}$ inch) below the mucocutaneous junction. Then join this with an incision on each side of the loss of substance and perpendicular to the free border of the lip. In this way two square-ended flaps are formed which are drawn together and sutured.



FIG. 625.—Operation for reconstruction of a part of the vermilion border (*modified from Nélaton and Ombrédanne*).—1 and 2. The dark lines indicate the outline of the flap A and B. They are shifted inward and sutured.

Defects of a considerable width may be closed in this way, as the vermilion border is very extensible.

Total Destruction of the Vermilion Border of One Lip.—For the relief of this condition Dieffenbach, after freshening the defective lip



FIG. 626.—Operation for the reconstruction of the vermilion border (*Dieffenbach*).—1 and 2. The lower lip is freshened and a small flap of the vermilion border is taken from each side of the upper lip. These flaps are brought down and sutured together to form a border for the lower lip. If too much constriction follows, the commissures may be lengthened.

takes a flap from the outer third of the vermilion border of the other lip, on each side, and sutures it to complete the border of the defective



FIG. 627.—Operation for the reconstruction of the vermilion border (*Tripiier*).—1 and 2. The lower lip is freshened by excision of the area between the points A and B. The double-pedicated flap of mucosa CDEF is raised from behind, and is shifted forward into the defect. The raw surface left by raising the flap is closed by suture, or allowed to granulate.

lip. This method is not desirable because the mouth is considerably shortened. However, this shortening can be subsequently overcome by lengthening the commissures.

Berger used a pedunculated flap of the mucous membrane of the cheek to form the vermilion border, but these flaps are not dependable. They will often slough when used for this purpose, and little or nothing will be gained.

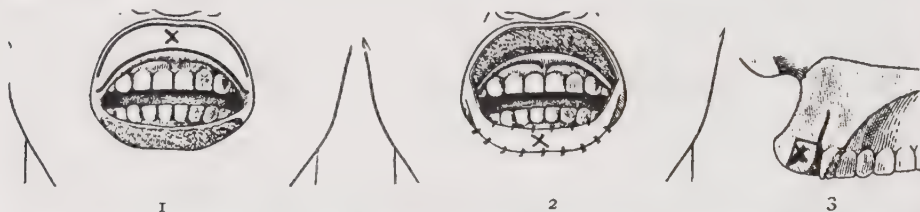


FIG. 628.—Operation for the reconstruction of the vermilion border (*Schulten*).—1 and 2. The double-pedicated flap X is raised from the upper lip and shifted down to fill the defect in the lower lip. The pedicles are divided subsequently if necessary. 3. Note the thickness of the flap.

Double-pedicated flaps of mucous membrane from the same lip, or from the normal lip, have been used with success. Their use is more likely to be successful than the methods previously mentioned.

Tripier used a flap with a pedicle on each end obtained from the mucosa of the same lip behind the defect, and shifted it forward to

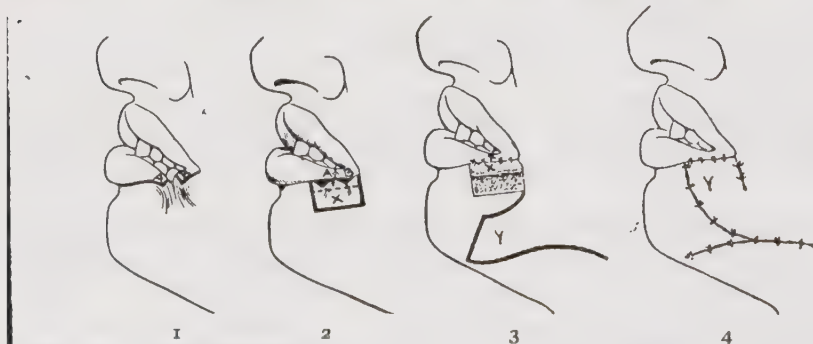


FIG. 629.—Operation for reconstructing a portion of the vermilion border (*Berger*).—The dark lines indicate the incisions liberating the extremities of the vermilion border and B. 2. A is sutured to B. The dark triangles beneath indicate defects opening into the mouth. The flap X with its base indicated by the dotted line, is turned up and sutured to the under surface of A and B. 3 and 4. The raw surface is covered by the flap Y.

fill the gap. Schulten used a flap of the same type, although considerably thicker and markedly curved, obtained from the other lip. The pedicles were close to the angles and the flap was shifted and sutured into the defect. The raw surface from which the flap was obtained was closed at once. If any redundant tissue in the region of the pedicles proves to be annoying it can be subsequently removed.

I have seen one case of complete replacement of the outer edge of

the red border of both lips, with scar following a burn, in which the deformity was not especially marked except that the lips were abnormally white. However, when the patient attempted to open his mouth widely, the appearance was much like that which would have been caused by a purse-string suture, an opening being left about 2.5 cm (1 inch) in diameter. This deformity was completely corrected by ex

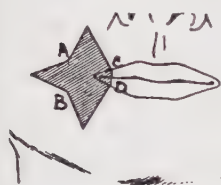


FIG. 630.

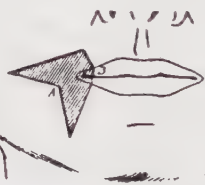


FIG. 631.

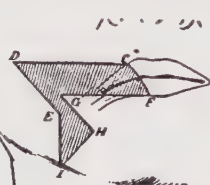


FIG. 632.

FIG. 630.—Operation for loss of substance of the commissure (*Erichsen*).—The shaded area is the shape of the excision. A is sutured to C, and B to D.

FIG. 631.—Operation for loss of substance of the commissure (*Serre*).—The excision made in the form of a half-star. The point A is then sutured to B.

FIG. 632.—Operation for loss of substance of the commissure (*Serre*).—The excision was made in the form shown by the shaded areas. The point G was sutured to D, F to C, E to H, thus relieving the deviation of the commissures.

cision of the scar around the mouth, shifting forward the normal mucous membrane, and suturing it to the skin.

Partial Reconstruction.—In partial reconstruction of the lower lip the restoration of the vermillion border is of the greatest importance. In these cases it may be of advantage to utilize flaps of scar tissue in lining the defect, covering the surface with flaps of normal tissue from



FIG. 633.—Operation for deviation of the commissure (*Szymanowski*).—1 and 2. The dark line indicates the incision. The flap A is lowered and placed above the flap B.

the desired region. In a case with contracture and destruction of the vermillion line near the angle of the mouth, and with adherence of the lip to the jaw, Berger was able to restore the vermillion line by dissecting out the ends and suturing them together. In this way he formed a sort of bridge over the underlying scar which opened into the mouth. In order to line the cavity beneath this bridge, he then cut a rectangular

flap from the scar below with its base at the defect and turned it up, and after separating the lip from the mandible, sutured it to the mucous border inside, thus lining the defect below the vermilion border. The surface was covered with a pedunculated flap from the chin.

Slight Loss of Substance of the Commissure—Where there has been loss of substance of the mucosa of the commissure there is usually an adhesion of the lip, and a consequent partial atresia. The loss of substance following the excision of a tumor has been corrected by the formation of flaps to draw the commissure outward.

Serre and also Erichsen have utilized this method, and I have found it a very valuable procedure. The diagrams will indicate the lines of the incisions.

Deviations of the Commissures.—In contracted scars following burns we often find the commissures either pulled downward or upward.

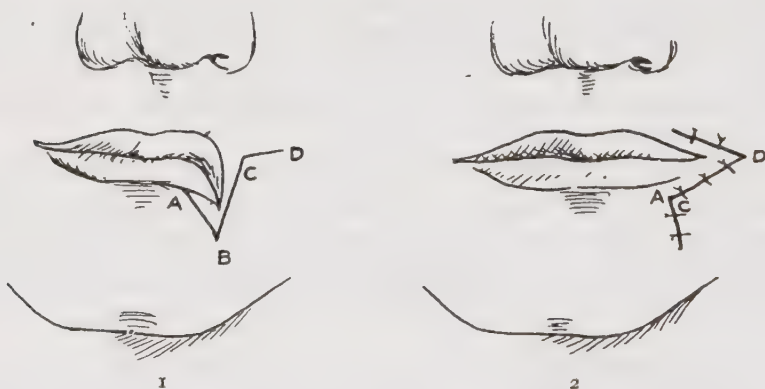


FIG. 634.—Operation for the correction of downward deflection of the commissure.—1. The dark line indicates the outline of the flap ABC. 2. The point B is sutured into the line CD at D, and C to A.

Many methods have been devised for overcoming this deformity. Some of these operations, such as that of Serre for raising the commissure, depend on the excision of a more or less extensive area of tissue, the lines of which are so planned that when the edges are approximated the deformity will be corrected.

The other type is represented by the operation of Szymanowski, in which the commissure is raised. In this operation there is simply the transposition of flaps without excision of tissue. He frees the vermilion border and then raises a pedunculated triangular flap from the cheek, its tip directed toward the internal angle of the eye, its base being below the ala. This flap is brought down and sutured above the red border

which has been previously freed, the tip being at the end of the liberating incision near the midline. All other wounds are then closed.

TO RELIEVE CONSTRICTION OF THE BUCCAL ORIFICE (MICROSTOMIA)

In some instances following ulceration (tuberculous, syphilitic, or occasionally small-pox) or burns, the buccal orifice is narrowed without any important destruction of the lining membrane.

In these cases, which may vary in extent from partial occlusion to almost complete closure of the mouth, there is more or less difficulty in introducing and masticating food, in keeping the mouth clean, and furthermore there is more or less marked deformity.

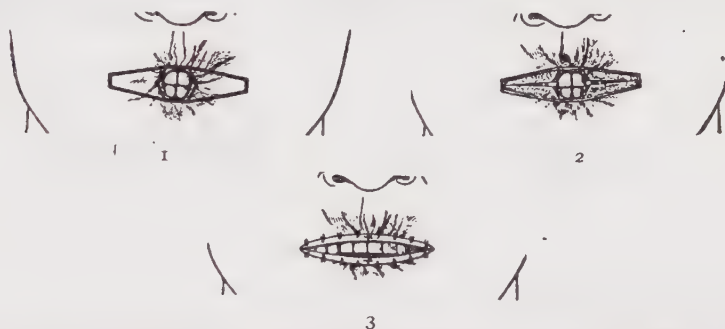


FIG. 635.—Operation for the relief of constriction of the buccal orifice (*Werneck*).—1. The dark line indicates the incisions for the removal of the skin and scar tissue. The incisions through the mucosa. 3. The flaps of mucosa sutured to the skin to form the borders of the lips.

Dilatation has been tried thoroughly, but has proved useless. Simple division of the angles without suture was also tried at one time, but was always followed by a prompt recurrence.

The cheek has been perforated on each side in the situation of the proposed commissure, and a lead or silver ring inserted. After healing was complete the tissues were divided to this point. This method slow and unsatisfactory.

In the correction of this deformity some plastic operation should be utilized in which the epidermization will be prompt and the chance of recurrence eliminated.

Werneck's Operation (1817).—A narrow ellipsoid incision of the desired length (the ends of which are square) is made transversely to surround the contracted orifice. All the skin included in this area

excised, care being taken not to cut through the mucosa. The latter is then divided horizontally in the midline from the opening to the commissure, and the edges are sutured to the skin.



FIG. 636.—Operation for the relief of constriction of the buccal orifice (*Dieffenbach*).—The skin has been excised. The dark lines indicate the formation of the flap of mucosa. Note the triangular flaps to line the commissures. 2. The skin and mucosa sutured together to form the commissures and lip borders.

Dieffenbach employed a similar method, but instead of dividing the mucosa completely back to the commissure, he made use of a Y-shaped incision leaving a triangular flap of mucosa at the commissure which



FIG. 637.—Combination operation for the relief of constriction of the buccal orifice (*modified from Nélaton and Ombrédanne*).—1. Outline of skin flaps. 2. Skin flaps raised and mucous membrane divided.

was brought forward and sutured to the skin, thus assuring a more stable and comfortable angle.

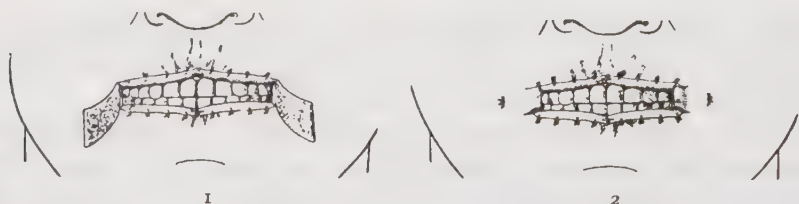
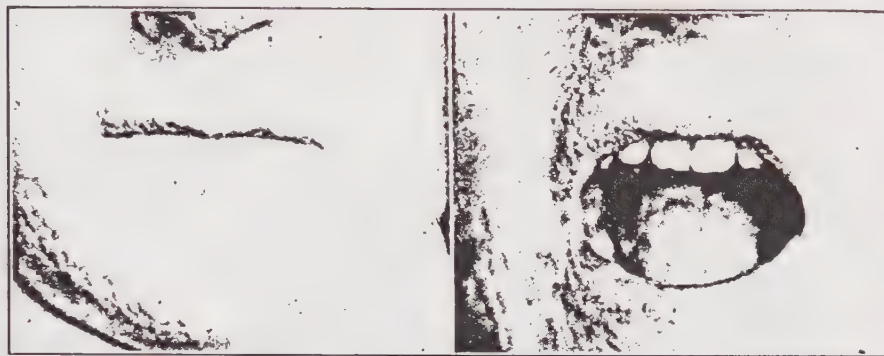


FIG. 638.—Combination operation for the relief of constriction of the buccal orifice, *continued*.—1. The mucosa flaps sutured to the skin to form the lip borders. 2. The skin flaps after being shortened are turned in to line the commissures.

Werneck subsequently formed the commissure by turning in a flap of skin after excising the mucosa. In this operation he did not utilize the mucosa as in his first operation.

I have had excellent results with Dieffenbach's triangular flap of mucosa to form the commissures. Nevertheless, there is much to be

said in favor of forming the commissures from small skin flaps which are turned in and sutured to the mucosa within. At the same time the mucosa which is behind the constricted portion should be utilized in covering the margin of the lips. In other words, a combination of

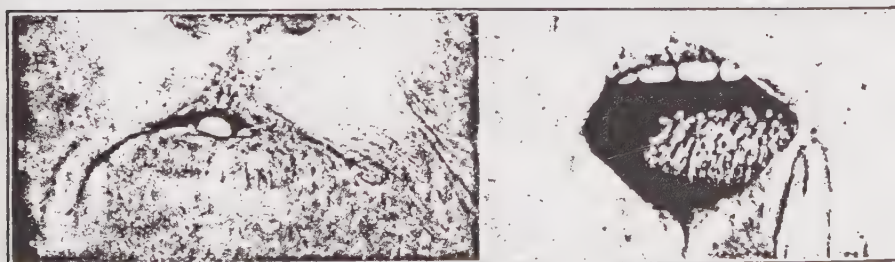


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FIG. 639.—Result of enlarging the buccal orifice after atresia following a burn of the mucous membrane.—1 and 2. The outer margin of the vermillion border around the entire mouth had been burned, together with the surrounding skin. The mouth could be opened only wide enough to admit a teaspoon. The constriction being somewhat like a puckering string. The photographs were taken six months after the excision of the constricting band, with plastic reconstruction of the commissures and vermillion border.

Werneck's first and second operations seems to be the best for assuring the commissures and avoiding recurrence. I have not found any group of patients who are more grateful than those who have been relieved from marked atresia of the mouth.



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FIG. 640.—Microstomia following severe infection.—1. Note the shortening of the upper lip and the narrowing of the mouth. 2. Result of lengthening the upper lip by shifting in lateral flaps. The angles of the mouth were then lengthened, and the commissures were lined with mucous membrane.

Another type of narrowing of the buccal orifice, which follows noma, is more difficult to correct. There is loss of substance and destruction of the neighboring buccal mucosa. The orifice is narrowed and the

cheeks are bound down to the jaws by dense cicatricial bands which lock them. The adherent portions must be separated and the cheek lined by one of the procedures described elsewhere. The mouth may then be made as broad as is desired.

ABNORMALLY LARGE MOUTH (MACROSTOMIA)

The mouth may be abnormally large (congenitally) and in some cases it is necessary to reduce the distance between the commissures. A slight correction may be accomplished by making a V-shaped incision on each side through the full thickness of the cheek at the proper distance from the angles. The apex should be outward and on a level with the commissures. The triangular flap between the legs of the V is



FIG. 641.—Deformity following luetic ulceration of the mouth.—1. The ulcer in its active state. 2 and 3. Taken eighteen months later, after salvarsan and local treatment. Note the enormous size of the mouth and the extensive infiltration with scar tissue.

then shifted toward the median line, and the wound is sutured in the shape of a Y. In marked cases, whether congenital or acquired, it is necessary to separate the tissues and suture them in layers—mucous membrane to mucous membrane, etc. Great care should be taken to line the newly constructed commissures with mucous membrane or skin.

ECTROPION OF THE LIPS

By ectropion is meant the eversion of the free border of the lip so that the mucosa is permanently exposed to the air. The deformity is

usually caused by contracted scar on the skin surface of the lip. Every gradation is encountered, from partial eversion of a portion of the lip to complete eversion of the whole lip, so that the entire mucous lining is exposed to the air.



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FIG. 642.—Deformity following luetic ulceration, *continued*.—1 and 2. No attempt was made to remove the scar tissue at this time, this being reserved for a subsequent operation. The mucous membrane was loosened above and below. The commissure was lined with flap of mucosa which was especially broad at the point selected for the angle of the mouth. The scar tissue with some normal tissue was freed, and shifted into position, an effort being made to reconstruct the cheek on that side. The result is shown in the photograph.

In old cases the alveolar margin may also be everted and the teeth project forward. The bone is atrophied, and the teeth are usually



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FIG. 643.—Operation for the relief of ectropion of the upper lip (*Behrend*).—1. A narrow ellipse of tissue is excised transversely through the full thickness of the lip. 2. The lip is drawn down and the wound is sutured vertically.

decayed, there is constant drooling of saliva, and in extensive cases the deformity is revolting.

Ectropion of the lips is often associated with contracted scar involving the neck with the fixed point on the clavicle or chest. I

these cases the head is bent forward, and I have sometimes seen the everted lower lip covering the sternal notch.

Ectropion of the Upper Lip.—Ectropion is much less frequently found in the upper than in the lower lip. In the less extensive eversions Behrend's operation may be useful. He excises a narrow ellipse of tissue transversely through the full thickness of the lip, about midway

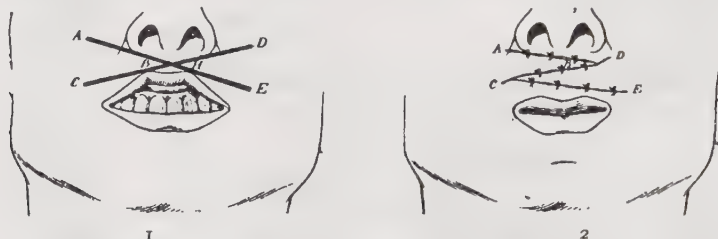


FIG. 644.—Operation for the relief of ectropion of the upper lip (*Teale*).—1. The dark lines indicate the incisions made to form the flaps. 2. The lip is pulled down. The triangle B-C is superimposed over the triangle D-H-E. The point H being sutured at C, and the point B at D.

between the nose and the lip margin. After loosening the tissues he sutures the wound vertically and in this way lowers the margin.

Teale's Operation.—Two very oblique and almost horizontal incisions are made through the lip. These cut each other in the midline, thus forming two triangles with their apices at the middle of the lip. The flaps are loosened, shifted inward, and superimposed, so that each



FIG. 645.—Blasius-Wharton Jones' operation for the relief of partial ectropion of the lower lip.—1 and 2. The dark line indicates the V-shaped incision. The lip is liberated, the wedge of tissue A is shifted upward, and the wound is closed.

apex is sutured to the base of the opposite triangle. In this way the lip is lengthened and the margin lowered. The difficulty is that the tips of the long narrow triangles may slough, but despite this good results may be obtained.

Szymanowski liberates the margin of the lip by a transverse incision and lowers it, and then fills this opening by using a flap from the cheek on each side. In my own experience, in pronounced cases, the use of a

double-faced pedunculated flap from the arm has proved the method of choice. The use of flaps from the forehead has not proved satisfactory.

Ectropion of the Lower Lip (Partial)—Where the ectropion is slight and involved only a portion of the vermillion border, Blasius's or Wharton Jones' operation is often sufficient. The cicatrix is loosened



FIG. 646.—Operation for the relief of partial ectropion of the lower lip (*modified from Nélaton and Ombrédanne*).—1 and 2. The dark line indicates the incision. The lip is liberated and raised. AB' is sutured to AC' , being buttressed on the triangle of tissue BXC . The flaps $BDFK$ and $CEHL$ are shifted inward and sutured.

by means of a V-shaped incision of sufficient width and the vermillion border is restored to its proper position. (I have found over-correction to be advisable in these cases.) The wound is then sutured so that it will assume the shape of a shallow Y or T.

Nélaton and Ombrédanne use a much more complicated incision for the same purpose which gives a fixed point on which the tissue to be

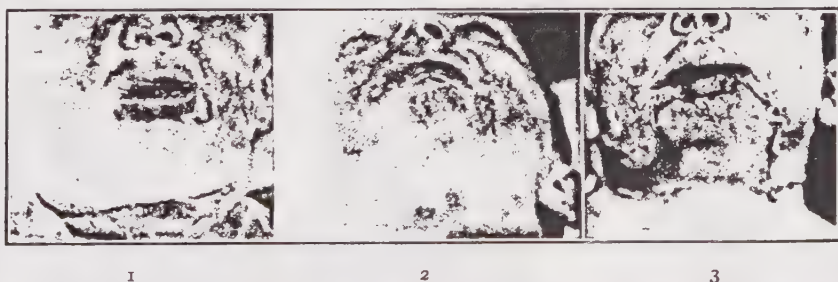


FIG. 647.—Contracture of the chin with ectropion of the lip following a burn. Duration nineteen months.—1 and 2. A thick keloid-like scar involves the lips, chin and cheeks. 3. The scar on the chin was excised and a flap from the neck with pedicle below was shifted upward and sutured to the lip.

shifted upward may be supported. The technic can be clearly understood from the diagram.

All varieties of incisions have been made for relieving the eversion and each case will require the one appropriate to it. Those that have mentioned may be regarded simply as suggestions. Skin grafts have been used to fill the defects after relief of the ectropion, an

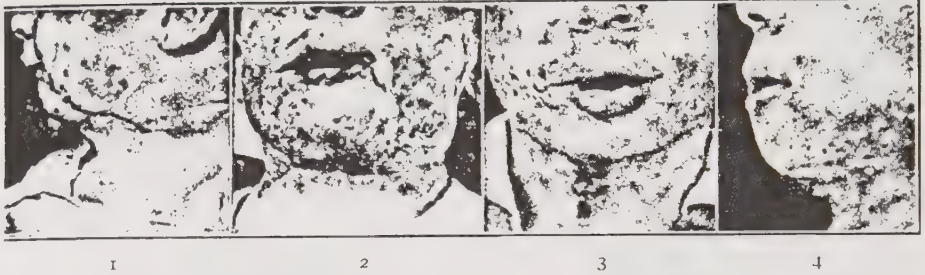


FIG. 648.—Contracture of the chin, *continued*.—1. Profile view of the flap with pedicle below. 2. Seven months later the pedicle was cut and the flap was shifted upward. The defect below was closed by undercutting and sliding. 3 and 4. Three years later the angles of the mouth were raised and the scar on the neck was excised. The use of a flap from the neck of this type is, as a rule, not to be advised. However, by waiting until it is thoroughly contracted and then dividing it transversely and shifting it upward as far as desired, it can be utilized with success.

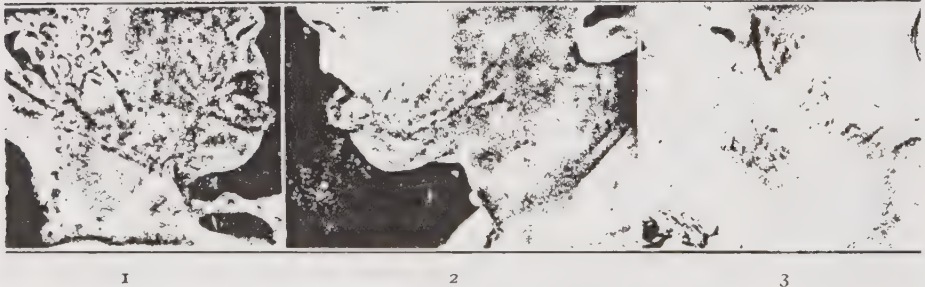


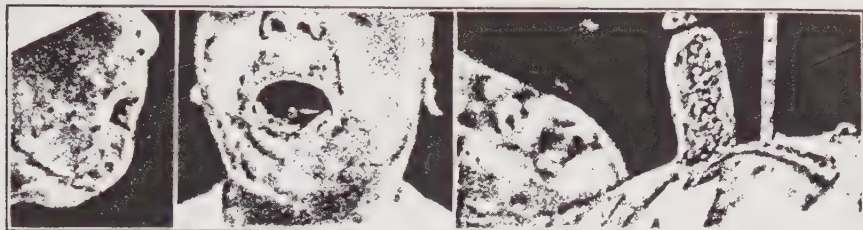
FIG. 649.—Ectropion of the lower lip with involvement of the neck and cheek following a burn. Duration eight months.—1 and 2. Note the greater involvement of the right side. 3. A close view of the pedunculated flap from the arm sutured to the left cheek, with horsehair stitches still in place.



FIG. 650.—Ectropion of the lower lip, *continued*.—1. The cast in place. Note the position of the arm and freedom of the face and mouth. 2. After removal of the cast, the flap can be seen still attached to the arm before division of the pedicle.

occasionally give good results. A graft of whole-thickness skin is to be preferred.

In some cases the Indian method may be used to advantage in conjunction with the foregoing procedures.



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FIG. 651.—Contracture of the mouth and chin following a burn.—1. The dense scar surrounding the mouth and involving the cheeks, chin and nose. Note the extent of inability to open the mouth. 2. Result of operations to temporarily relieve the contracture of the mouth. 3. Inasmuch as extensive visible scars had to be avoided in this case a flap was raised from the abdominal and chest wall with its pedicle above, and an attempt was made to insert the free end of this flap into an incision near the clavicle, and later to cut the lower pedicle and by the same process to finally raise the flap, so that it could cover the chin. This procedure was a failure for several reasons and the original pedicle was never severed. Then the under surface was grafted and the patient was sent home.

Complete Ectropion.—In the very extensive cases, of all the many methods suggested, only one is worth trying, although it is usually resorted to only after long temporizing. Of course if the head is drawn forward and the ectropion is due to extensive involvement of the neck as well as of the chin, the correction of the contracture of the neck



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FIG. 652.—Contracture of the mouth and chin, *continued*.—1. The flap on the chest wall nine months later. Note the contracture of the grafted surface. 2. This was easily straightened on account of the thick underlying pad of fat, and the freshened edge was inserted into an incision on the radial side of the wrist and forearm, and after two weeks the pedicle was cut from the chest wall and the flap was nourished from the forearm. The scar on the forearm after transfer of the flap to the chin.

must first be looked after. (See Chapter on the Neck.) The use of a flap from the arm, either by double or single transfer, is the method of choice. The procedure which I have found most satisfactory is as follows:

The entire mucosa is loosened and turned upward. It is usually found to be hypertrophied and it may be necessary to trim the edges. The scar on the chin is then dissected up from above downward as a flap, the dissection being complete on the side opposite the arm from which the flap is to be obtained. The scar on the same side as the arm

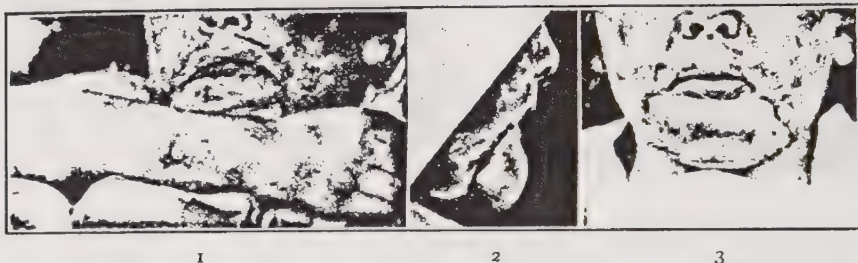


FIG. 653.—Contracture of the mouth and chin, *continued*.—1. The flap on the forearm attached to the chin. 2. Two weeks later the flap was cut away from the forearm. 3. The flap two weeks after final suturing covering the entire chin.

to be used is not completely removed (if it is extensive) because it is not possible to suture the pedicle of the flap closely to this area. It is better to wait until the pedicle is cut and then remove that portion of the scar, and fit in the pedicle. All undamaged muscle tissue should

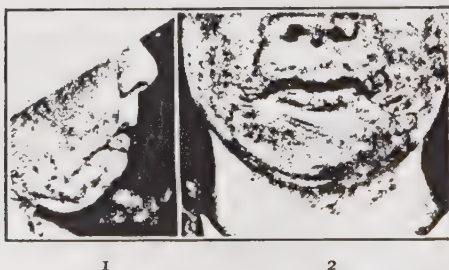


FIG. 654.—Contracture of the mouth and chin, *continued*.—1. Profile view of the patient two weeks after final suturing. 2. Result four and a half years after implantation of the flap on the chin. Several secondary operations were done during this period. Note the appearance of the chin and the normal size of the mouth. In transplanting this flap an interval was always allowed to elapse between the cutting of the pedicles and the further transfer of the flap. In this way all necrotic tissue was taken care of and shrinkage took place. In consequence, there has been no shrinkage of the flap since. The color of the flap matches the adjacent skin exactly and the result, as far as the chin and lip is concerned, is excellent.

be preserved in the dissection. A carefully calculated flap of sufficient size and proper shape is then raised from the arm and sutured into the defect; the suturing should be as accurate as possible, especially along the vermillion border. The scar tissue flap below may be trimmed and the edge sutured to the arm flap; or the arm flap may be sutured to

the base of the inner surface of the flap of scar which is then brought up, so that it overlaps the arm flap. Every portion which by thi



FIG. 655.—Ectropion of the lower lip caused by contracture following a burn. Duration eight years.—1. Note almost complete eversion of the lower lip. Also the involvement of the entire skin of the face with scar tissue. 2. The plaster cast which immobilizes the arm and head while a flap from the arm is being transferred to the chin. 3. The flap still attached to the arm and adherent to the chin. Two weeks after operation.

time definitely shows a lack of blood supply is, of course, trimmed of Horsehair and silkworm gut is the suture material of choice. Drainage is established at dependent portions, and the arm is secured in a plaster cast so that there is no tension on the flap. In from ten to fourteen days the pedicle is cut and the arm is lowered. The scar beneath the pedicle of the flap is then excised and the pedicle is fitted in. One of the methods previously described for conserving the circulation of the arm flap, and at the same time permitting shrinkage before transplantation, is well worth considering, and in many cases will save time.



FIG. 656.—Ectropion of the lower lip, *continued*.—1 and 2. One year after the implantation of the flap from the arm.

months I have transplanted this flap into the forearm and sub

I have been quite successful in raising a flap from the abdomen and grafting the under surface. Then after seven

quently, after severing the pedicle from the abdomen and allowing the circulation to completely adjust itself, have transferred it to the chin and lip, after freshening the under surface.



FIG. 657.—Ectropion of the lower lip following a burn eleven years previously.—1. This case is shown in order to emphasize the difficulties sometimes encountered in securing normal skin for flaps. The entire face and neck, the upper portion of the chest and back, and both upper extremities to the finger tips are covered with scar tissue. 2. The lower lip is everted and the photograph is taken with the lip held as high as possible.

I have used the arm flap in children as young as three years, and find that they do not mind the enforced position after the first day.

Several secondary shaping operations may be necessary to raise or lower the angles, to make the vermilion line symmetrical, and to



FIG. 658.—Ectropion of the lower lip, *continued*.—Result of using a double-pedicle flap of scar tissue for the relief of ectropion. 1. One week after the excision of the dense scar on the chin and relief of the ectropion. The double-pedicle flap has been shifted upward and covers the chin. 2 and 3. Result one year after operation. There has been considerable improvement and the tissue on the chin is of better quality than that removed at operation. Much more can now be done to improve the present condition.

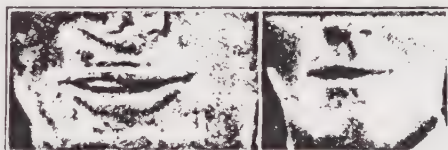
excise any scar tissue that may have been overlooked, but the ultimate results are most satisfactory. The flap may be too thick, especially if a double transfer from the abdomen is used, but the excess fat can be removed without difficulty. The tendency of these flaps is to lessen in thickness as time goes on, and with the excision of the surrounding

scar and the gradual stretching of the flap, what appears to be an excessive thickness is soon reduced.

There is usually some slight infection along the suture line in all these cases, and for this reason I prefer the interrupted on-end mattress suture, so that the removal of one or two stitches will not affect the others. It is most important that all hemorrhage be checked before the flap is transplanted.

The utility of Ollier-Thiersch grafts on the chin for the relief of contracture is doubtful.

Ectropion of the mucous membrane is usually congenital, and is due to hypertrophy of the mucous and submucous tissue. I have been able to correct this type of eversion of the entire vermilion border on both upper and lower lips, by the excision of an elliptical piece of mucous membrane and submucous tissue taken transversely from the inside of



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FIG. 659.—Redundant mucous membrane of the lip.—1. The redundant mucosa can be seen. It extends the full length of the upper lip and is much less tightly drawn than the vermilion border. There is also slight notching in the midline of the lip. 2. A large ellipse of mucosa was removed transversely, and two small areas of similar shape were excised at right angles to it. Photograph taken eight months after operation.

the lip. In addition, when the tissue is very redundant, I find that the excision of areas of suitable shape at right angles to the ellipse already mentioned will aid materially in correcting the deformity (Fig. 659).

CHEILORRHAPHY (SUTURING THE LIPS TOGETHER)

Abbe in 1898 held the lips together by sutures without freshening the edges as a secondary procedure in his operation for widening the upper lip. Morestin in January, 1913, reported that he had sutured portions of the lips together as a temporary measure in certain plastic operations around the mouth. He has again brought this procedure into prominence, and has found it most useful in reconstructive work following war wounds in this region.

The lips may be united from the midline nearly to the commissure on one side. The mid-portion of the lips may be united for the full extent except for a short distance at each angle. The union may be used

maintain the good position of the lip which has already been repaired; in atypical plastic operations on the lips and for eversions following burns.

Technic.—Under a local anesthetic the free border of each lip is divided (along the selected portion) by an incision 0.5 cm. ($\frac{1}{2}$ inch) deep near the anterior margin of the vermilion border. Buried sutures of catgut are used to unite the raw surfaces, and horsehair or fine silk for the skin. Adhesions should be freed before the incisions are made. The commissures should not be disturbed unless they are implicated. The non-absorbable sutures are removed after eight days.

To separate the lips, a sound or curved clamp having been passed behind the line of union, they are carefully divided and the wound in each lip is sutured.

Cheilorrhaphy is usually done as a preliminary to plastic reconstructive work, the lips being left attached for months if necessary. The border of the incomplete lip may be sutured to the opposite lip, or the newly formed lip may be sutured to the opposite lip to prevent contracture. Flaps destined to reconstruct the lip may be sutured directly to the opposite lip, and later be used for the desired purpose.

Numerous objections have been raised to the method—difficulty in talking, in expectorating, in feeding, and in keeping the mouth clean—have been used as arguments against it. But all of these inconveniences have been easily overcome, and experience has shown that the patients are quite happy and comfortable.

The fixation prevents contracture during the healing, and this is the main object of the procedure. It allows operations to be completed successfully which would otherwise only partly accomplish their purpose. The use of skin grafts in this region is much facilitated. It introduces a method of precision in operations on and around the lips which cannot be obtained otherwise. It has been suggested to me that complete closure of the lips would be advantageous in certain conditions, but I do not feel that this should be considered under any circumstances.

Jacobson splints the lip, after it has been loosened, by means of a rigid silver probe sharpened at one end. He inserts the probe through the cheek about 0.625 cm. ($\frac{1}{4}$ inch) above and outside of the angle of the mouth (any desired position may be chosen) and passes it submucosally along the lower lip piercing the other cheek at a corresponding point. The probe is then passed through a small gauze pad on each side; a perforated shot is placed outside the gauze, and the excess of the

probe is cut away. If the probe is not inserted too close to the mucous surface and there is no sloughing, then it may be allowed to remain in position for some time. I have found that there is less danger of infection at the points where the probe extends through the skin if the edges are sealed with collodion or with evaporated compound tincture of benzoin. I would also suggest that a puncture wound with a narrow knife is advisable at the point of insertion, instead of driving the probe through the skin.

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CHAPTER XXII

SURGERY OF THE CHEEK (MELOPLASTY)

Some very interesting problems are presented by cheek defects following injury, operation or disease.

Superficial defects in the cheeks may be caused by the excision of tumors, by ulceration, or by injury. Destruction of the whole thickness of the cheek may be due to injury (especially war wounds) to the removal of tumors, to disease (syphilis, tuberculosis, noma, etc.).

LOSS OF SUBSTANCE OF THE CHEEK MAY BE CLASSIFIED AS FOLLOWS: (1) *When the defect is in the skin only*, the treatment may be (a) by skin grafting (Ollier-Pihirsch; or whole-thickness grafts); (b) by sliding flaps; (c) by flaps from neighboring skin (Indian method).

(2) *Where the main portion of the defect is in the skin, but in addition there is a small opening into the buccal cavity, without fracture of the jaw*.—This may be treated (a) by freshening the edges and drawing the wound together with sutures if the defect is small; (b) by sliding flaps; (c) with flaps from adjacent tissue (Indian method); (d) with flaps from a distant part (Italian method).

(3) *Where there is an extensive defect involving the entire thickness of the cheek*, it must be filled with flaps having epithelium on both sides; from the neck covered by a cheek flap; from the cheek covered by a neck or scalp flap; from the neck covered by a flap from the arm; from the arm, neck, or chest, by folding a flap on itself; from the arm, neck, or chest, after grafting the under surface of the flap before transplantation. Various other combinations may be used.

Extensive defects may be divided into two general groups: (1) Those in which restoration is feasible immediately after the destruc-



FIG. 660.—Fatal burn of the cheek.—A third degree burn of this size would not ordinarily be fatal. Marked toxic symptoms occurred. The situation and depth of the burn contraindicated complete excision, which could have been done on almost any other part of the body.

tive operation or injury. (2) Those due to ulceration of some soft part or extensive destruction, in which the restoration must necessarily be delayed until healing is complete. With this group there is nearly always associated contracture of the jaws due to dense scar which may involve the surrounding skin, muscle and mucous membrane—a contracture which is very difficult to overcome. In long-standing cases atrophy of the mandible is also usually found.

If the gap is small, and there is plenty of normal skin, but the jaws are locked, the cheek must be lined according to the method selected. If the gap is large, the surrounding skin scant, and the jaws are locked in addition to the problem of unlocking the jaws we are compelled to secure the skin from a distance for filling the gap in the mucous mem-

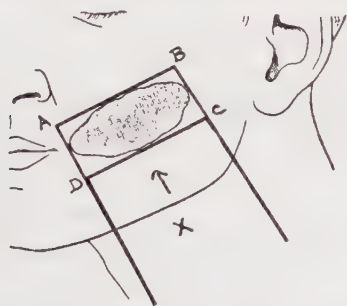


FIG. 661.



FIG. 662.

FIG. 661.—Operation for closing a cheek defect by the French method (*Serre*).—The area ABCD is removed, and then the flap X from the adjacent tissues is undercut and shifted upward to fill the defect. The edges are carefully sutured.

FIG. 662.—Operation for closing a cheek defect by the French method (modified from *Nélaton* and *Ombredanne*).—The dark lines indicate the incisions. The flap outlined is undercut and shifted in to close the defect.

brane, and also in the skin. In all complete cheek or lip defects, an inner as well as an outer lining has to be provided in order to prevent subsequent contracture.

SUPERFICIAL WOUNDS OF THE CHEEK

The Use of Skin Grafts.—In closing a superficial wound of the cheek which is too large to be sutured, if possible a single graft should be used. The graft may be of the Ollier-Thiersch variety, or of whole-thickness obtained from some region of the body in which the skin resembles the cheek as closely as possible in thickness and texture. I have had some very satisfactory results with whole-thickness grafts on the face, and prefer them to the Ollier-Thiersch grafts in this situation.

The *French method* of closing cheek defects by sliding has been extensively used by Morestin, after excising the scar, in old war wounds. The operation of Serre, as shown in the diagram, indicates the need of

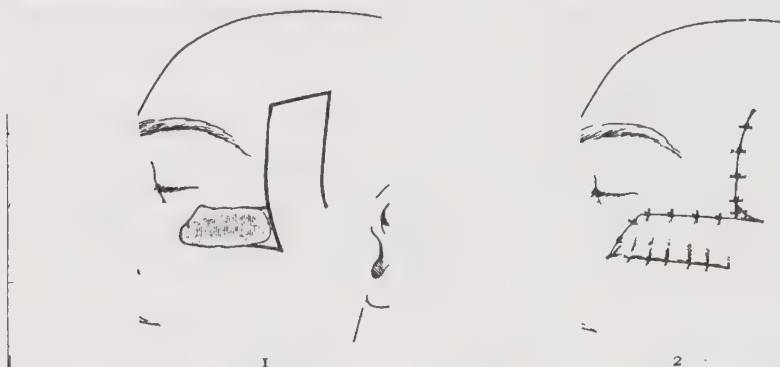


FIG. 663.—Operation for closing a cheek defect by the Indian method (modified from Jélaton and Ombrédanne).—1. The dark lines indicate the incisions. 2. The flap shifted into the defect and sutured.

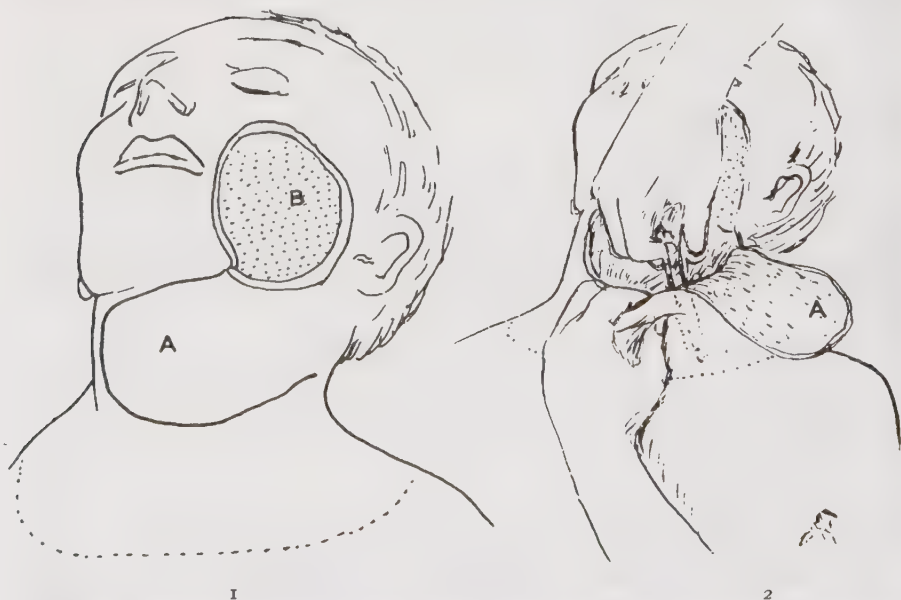


FIG. 664.—Method of closing a cheek defect with a flap from the neck after extensive mobilization of skin of the neck (Morestin).—1. The dotted area on the cheek indicates the defect. The dark line on the neck shows the outline of the flap. The dotted line indicates the lower limit of the area to be undercut and mobilized. 2. Shows the flap raised and the method of undermining the skin with scissors.

making very long incisions, and carrying out extensive undercutting in order to fill the gap. This may cause a good deal of asymmetry of the face, and in many instances is inadvisable.

Nélaton and Ombrédanne in their work have limited the use of the French method to the restoration of small defects situated immediately below the lower lid, but my experience has been that much wider use can be made of sliding flaps.

In using sliding flaps in the repair of a cheek defect care must be taken not to pull down the lower eyelid, or to distort the angle of the mouth. In other words, the operation must be planned in such a way as to avoid producing a new deformity while correcting an old one. Pedunculated flaps from adjacent skin are of great value in certain cases, and this method should always be given consideration when skin grafting is contraindicated.

METHODS OF REPAIRING DEFECTS IN THE MUCOSA

The mucous membrane lining the cheek may be destroyed by operation, injury or disease, and in these cases the loss of tissue must be replaced in order to avoid contracture. Gaps left by operation should be filled at once.

Repair with Pedunculated Flaps of Mucous Membrane.—If the destruction is not too large, it can be repaired with pedunculated flap of mucosa from the upper or lower lip; even the mucosa from the hard palate has been utilized.

Repair with Buried Grafts.—The cheek or adherent lip may be lined with epithelium by using a buried Ollier-Thiersch graft applied according to Esser's method. He prepares a cavity of the desired size and makes a cast of it with dental impression material. This cast, after being covered with a single Ollier-Thiersch graft (raw surface outside), is inserted into the cavity and the skin closed. Three weeks later the cavity is opened and the cast is removed, leaving the space covered with epithelium. The procedure is very useful at times but the results cannot be compared with those following the use of pedunculated flaps of whole-thickness skin.

Repair with Pedunculated Flaps of Skin.—Binnie describes an operation, probably based on Rotter's idea, for lining a cheek defect. If the defect is in the mucous membrane alone, a flap of suitable size and shape is raised from the neck with the pedicle above, and is inserted (skin side inward) in an incision through the cheek just in front of the masseter muscle. The neck defect is sutured or grafted. Ten days later the pedicle is cut, the end of the flap is sutured into the posterior portion of the defect in the mucosa, and the incision through the cheek

is closed. If it has been necessary in removing a growth to split the cheek, the neck flap may be sutured into the defect in the mucosa and the cheek closed over it, the rest of the procedure being the same as just described (Fig. 665).

Many operators line cheek defects by turning in the surrounding skin, and then covering it with a pedunculated flap from the neck. In my hands this has proved very useful in small defects through the full thickness of the cheek, in the absence of contracture of the jaws. (Fig. 666).

The use of hairy skin turned into the mouth has always been contraindicated, as the hair continues to grow, but this objection may be

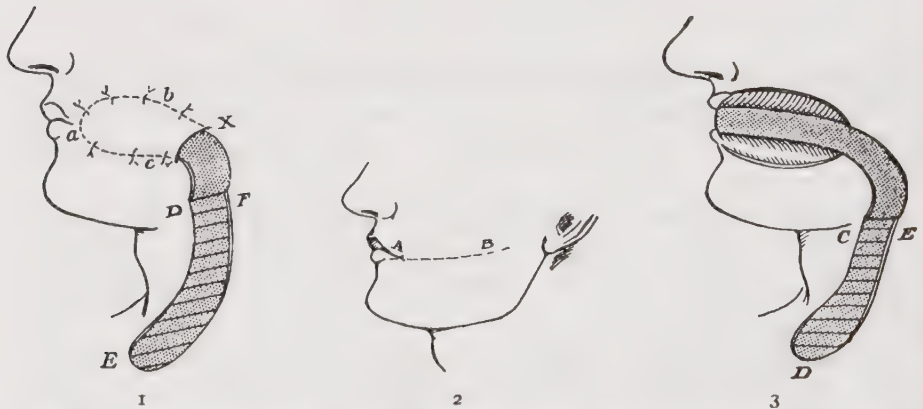


FIG. 665.—Method of lining a cheek after destruction of mucous membrane (*Binnie*).—1. The flap *DEF* from the neck is inserted in an incision through the cheek in front of the masseter, and is sutured into the defect in the mucous membrane *ABC*. Ten days later the pedicle is cut and all defects are sutured or grafted. 2. If the growth cannot be removed from the inside, the incision *AB* is made through the cheek. 3. The neck flap is inserted. The cheek flaps are closed over it, and then the same procedure is continued as in 1.

overcome by the use of x-ray or radium treatment of the flap before it is turned in. Cole has tested this procedure frequently in war wounds and finds that he can advantageously utilize flaps which without depilation would have been contraindicated. Hairless skin however, is to be preferred whenever it can be obtained (Fig. 667, 668, 669).

On several occasions I have turned up a flap from the neck with its base below the ramus of the jaw, and after passing it through an incision between the mandible and soft parts have sutured it into the defect in the mucous membrane. Two weeks later the pedicle was cut. The results were satisfactory.

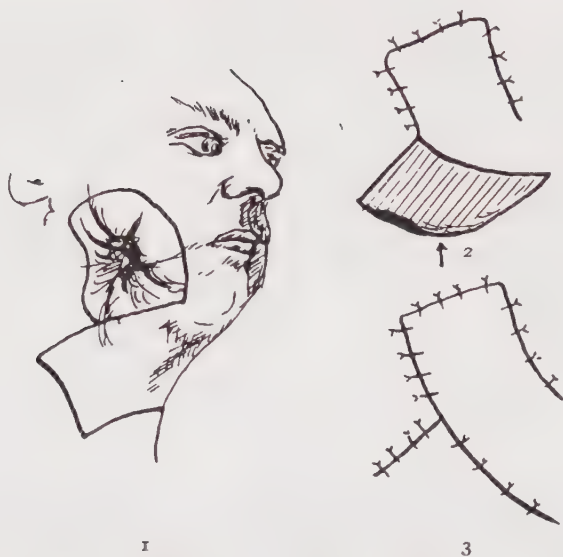


FIG. 666.—Method of closing a cheek defect (*Voeckler*).—1. The solid black line indicates the incision around the defect and outlining the flap from the neck. As much of the tissue as necessary from the margins of the defect is turned in and is used to line the cheek. The flap from the neck covers the raw surface as indicated in 2 and 3.

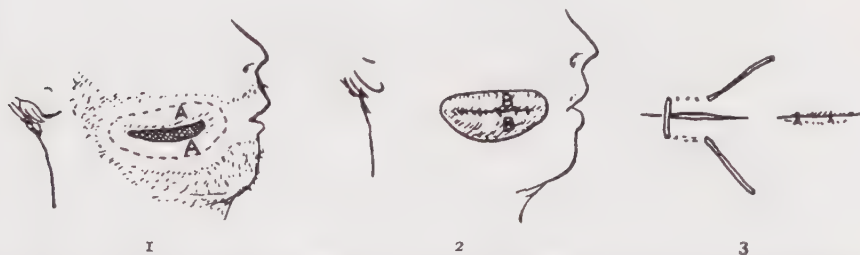


FIG. 667.—Operation for closing a cheek defect (*Cole*).—1. The dotted line indicates the incision through an area from which the hair has been removed by radiation. 2. The flap with the pedicle at the margin of the defect is turned in to line the cheek by means of the special suture shown in 3.

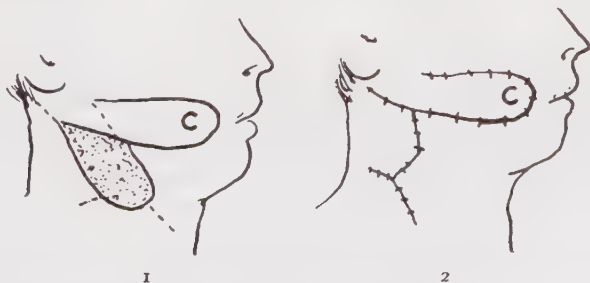


FIG. 668.—Cole's operation for closing a cheek defect, *continued*.—1. A pedunculated flap from the neck is shifted up to cover the raw surface. 2. The neck wound closed.

Gersuny's Operation (1887).—An incision is made from the corner of the mouth down to the border of the lower jaw, and backward to the anterior edge of the masseter. The flap thus outlined is raised,

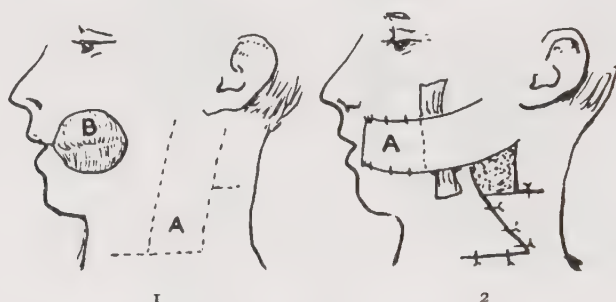


FIG. 669.—Operation for closing a cheek defect (*Cole*).—1. The defect in the mucous membrane of the mouth closed by skin obtained from the neighborhood, the pedicles being on the margin. The shaded area B indicates a raw surface. The dotted lines indicate the outlines of the pedunculated flap A from the neck. 2. The flap A shifted over to cover the raw area and a portion of the wound closed. The dotted line indicates the point of division. The pedicle is then used to fill in the defect on the neck.

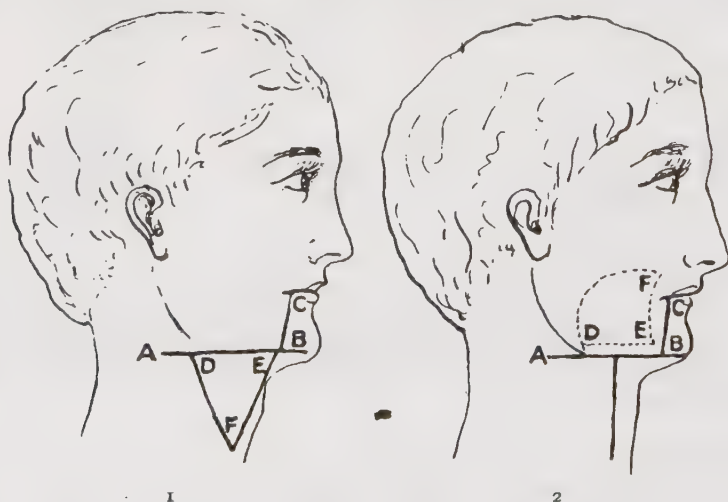


FIG. 670.—Method of lining the cheek (*Gersuny*).—1. The incision ABC is made through the full thickness of the cheek, and the flap is turned up. The incisions DF and FE are made which outline a flap large enough to line the cheek. 2. The flap is folded up until the skin side is inward, and is sutured into the defect in the mucous membrane. The pedicle is composed of the subcutaneous tissues. Then the cheek flap is lowered and sutured into position over it.

the growth is removed, or scar tissue is divided, and the flap is held upward. The under surface of this flap, from which mucous membrane is lacking, is covered with a flap from the skin of the neck, the pedicle of which consists entirely of the underlying soft parts and

periosteum along the mandible. The connection with the surrounding skin is completely severed, the flap is turned up, skin surface toward the mouth, and is sutured to the edges of the gap in the mucous membrane. The cheek flap is then turned down and sutured over this. This method is valuable in certain instances, one advantage being that the entire operation can be completed at one sitting. The disadvantage is that the circulation through the pedicle will not always be sufficient to nourish the flap (Fig. 670).

METHODS OF REPAIRING DEFECTS INVOLVING THE FULL THICKNESS OF THE CHEEK

Many operations have been devised for the repair of defects involving the full thickness of the cheek, but only a few of the best

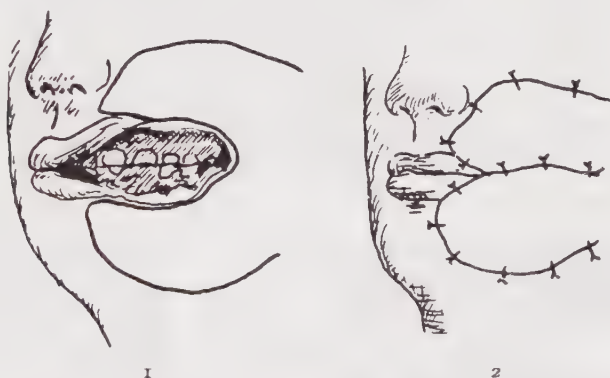


FIG. 671.—Method of closing a cheek defect. 1. The dark lines indicate the flap which are made through the full thickness of the cheek. 2. The flaps are approximate and sutured, and the soft parts above and below are drawn together to fill the gaps.

will be described here. In any one, some modifications in detail may be advisable to meet conditions peculiar to the individual case.

Kraske's Operation.—A flap of sufficient size to fill the gap is turned up from immediately below and is sutured into it. The pedicle through which nutrition is preserved for greater safety should include a portion of the skin, but may be entirely of subcutaneous tissue. When the bridge of skin is left, the pedicle is cut through after three weeks. By this method a raw area twice the size of the defect is left, which may be filled by sliding flaps, or by grafts, according to the nature of the case (Fig. 672).

Another method of closing a cheek defect may be illustrated by the following: A patient came under my care with a cheek lesion of three years' standing, following excision of the superior maxilla with

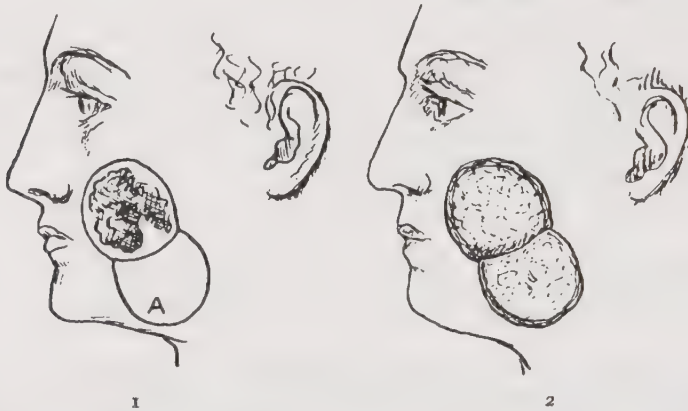


FIG. 672.—Operation for the repair of a cheek defect (*Kraske*).—1. The growth is excised. The flap A of sufficient size to fill the defect is raised from below, with its pedicle on, or close to the margin of the defect. 2. The flap sutured into the defect. The raw surfaces are grafted or covered with a flap from the neck.

overlying soft parts for sarcoma of the antrum. The condition is well shown in the accompanying figures. There was paralysis of the right corner of the mouth. The defect extended from the outer angle of the right eye to the nose, and well down on to the cheek. The eye

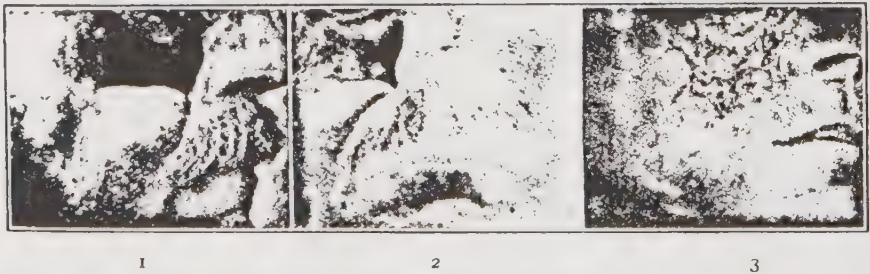


FIG. 673.—Cheek defect following excision of a sarcoma of the antrum three years previously.—1 and 2. Lateral and front views of the defect. 3. The defect was closed by means of a flap of tissue from the cheek below, the pedicle being at the lower rim of the opening. This flap was turned upward, skin side inward, and its edges were sutured under the loosened edges from around the margin of the opening. The raw surface was then grafted with Ollier-Thiersch grafts. The photograph was taken two weeks after operation.

was sagging, and was held by the soft parts only, the floor of the orbit having been removed. The lower lid was intact, the lachrymal sac was destroyed, the septum was missing; through the opening could be seen the nasal surface of the hard palate, and the action of the soft

palate in swallowing and speaking. In other words, this defect opened into the nasal and pharyngeal cavities and not into the mouth. The cheek just below the defect was quite thick, and covered with hairless skin which was not infiltrated with scar (Figs. 673 and 674).

OPERATION.—An incision extending from the nose to the outer angle of the eye was made along the lower outer border of the thickened cheek area, and a hinged flap of skin and fat (which filled the opening without difficulty) was raised with its pedicle near the inner rim of the defect. The soft parts were then loosened all around the other portion of the margin, and the edges of the hinged flap, with its skin surface inward, was sutured with mattress sutures, high up under the marginal flap, thus bringing raw surface to raw surface. The edge of the marginal flap extended over the raw surface of the hinged flap to some extent, and partly covered it. The remaining raw surface

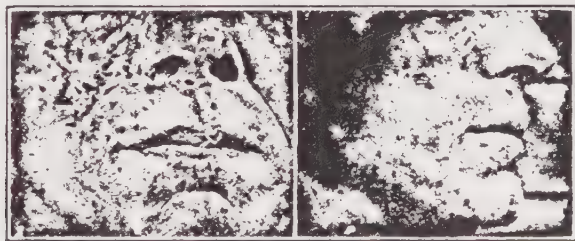


FIG. 674.—Cheek defect, *continued*.—1. Taken two weeks after operation. 2. Taken eighteen months after operation.

was immediately covered with an Ollier-Thiersch graft. There was no infection, and primary healing occurred. The patient was discharged two weeks after operation, much improved. In this method we made use of a thick hinged flap from below the defect, the raw surface of which was partially covered by the marginal flap from above. The remainder of the defect was grafted.

Cheyne and Burghard's Operation for a Small Gap in the Cheek without Contracture of the Jaws.—The edges are freshened, and the scar is excised. A flap (of skin and subcutaneous tissue) from over the masseter muscle, with its pedicle behind and near the defect, is raised, turned over so that skin surface is inward, and sutured to the edges of the mucous membrane. After healing is complete (two or three weeks) the pedicle is divided and sutured into the posterior portion of the defect, the flap is then raised from the skin over the jaw and is shifted upward to cover the raw surface of the first flap. Secondary

ary shaping operations are necessary to form the angle of the mouth, etc. (Fig. 675).

Shrady's Operation.—The cheek defect is closed by the double transfer of a flap from the lower portion of one arm above the elbow, which is implanted into an incision on the radial side of the forefinger of the other hand. In due time the flap is cut away from the arm and transferred on the finger to line the cheek. The flap is subsequently cut away from the finger, and the raw surface covered with sliding flaps from the neighboring parts.

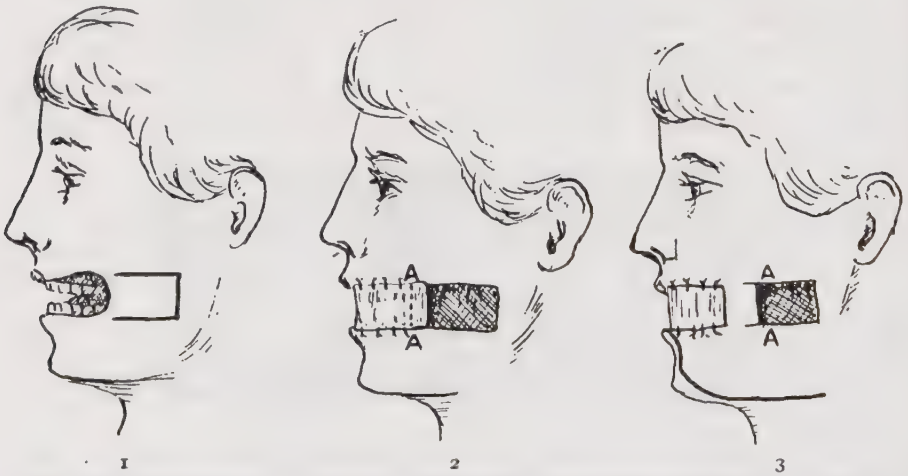


FIG. 675.—Operation for closing a cheek defect (*Cheyne & Burghard*).—1. The dark nes indicate the incision for raising a hinged flap. 2. The hinged flap raised, turned forward, sutured into the defect, skin side inward. The dotted line AA indicates the incision to divide the pedicle. 3. Two weeks later the pedicle is cut and the end of the flap is sutured into the defect. The dark line indicates the flap which is to be shifted up from the chin to cover the raw surface of the hinged flap. All other defects are sutured or grafted.

Czerny's Operation.—A flap is raised from the neck with its pedicle between the ear and the zygoma, and adjacent to the defect. It should be long enough to reach the most distant portion of the opening after the free end has been folded back on the body of the flap, so that epithelium covers on both sides. If the flap is shifted at once after folding and suturing raw surface to raw surface, it is united only to the sides of the cheek defect, the reflected edge and the base being subsequently sutured into position. If healing of the folded portion is allowed to take place first (which is preferable), the reflected edge is divided, and all but the pedicle portion is sutured into the defect. This is done subsequently, and several secondary operations may be necessary (Fig. 676).

Israel's Operation. FIRST STAGE.—A pedunculated flap of skin and subcutaneous tissue is raised from the skin of the neck. The pedicle is just below the angle of the jaw and is oblique in direction. The

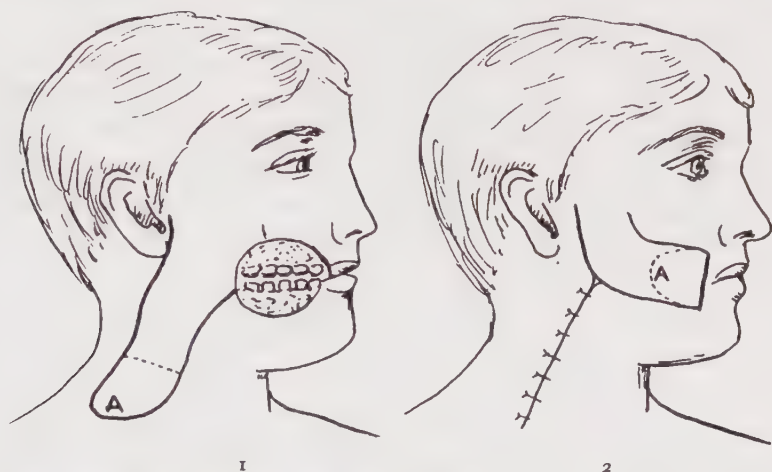


FIG. 676.—Czerny's operation for closing a cheek defect (J. S. Stone).—1. Outline of the flap. Note the position of the pedicle. The dotted line across the flap indicates the point at which the extremity is folded on itself. 2. The flap in position, and the neck wound closed.

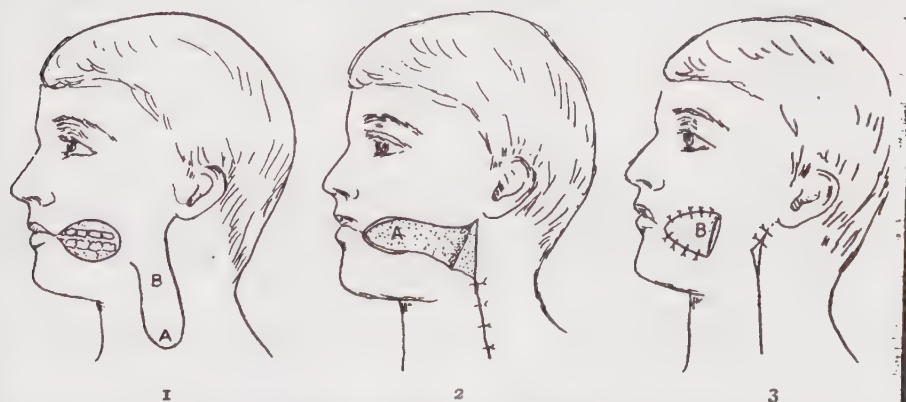


FIG. 677.—Israel's operation for closing a cheek defect (J. S. Stone).—1. The dotted line outlines the flap which is to close the cheek defect. 2. Flap raised, turned over, and sutured, skin surface inside to mucous membrane of the cheek. The neck defect closed. 3. The pedicle is severed and the flap is folded forward on itself and sutured. The posterior border of the double-faced flap is subsequently split and the margins sutured into the defect, thus completely closing it.

flap should be long enough when raised to reach the most distant point in the defect without tension, and wide enough to fill the gap. It must be remembered that flaps from the neck contract a great deal

and allowance must be made for this shrinkage. After being raised, the flap is turned over, skin surface inside, and its free end is carefully sutured to the loosened mucous membrane at the margins of the defect, except in the portion under the pedicle (Fig. 677).

It can be seen from this that the pedicle bridges over an area of normal skin, and the skin surfaces should be kept apart with gauze. The neck wound is closed, as far as may be, with sutures.

SECOND STAGE.—Three weeks later the pedicle is cut. The exposed raw surfaces having been freshened the posterior portion of the flap is turned forward and sutured, thus covering the raw surface of the

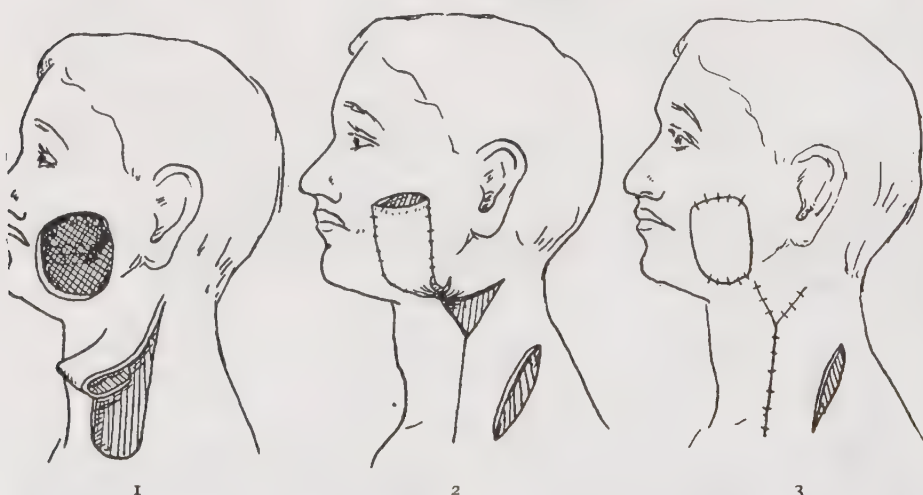


FIG. 678.—Method of closing cheek defect with flap from the neck (*Blair*).—1. Flap raised from the neck and folded on itself. 2. After healing is complete the flap is shifted into the cheek defect and its sides sutured to the freshened edges. 3. Two to three weeks after the pedicle is cut, the upper end of the flap is opened and both extremities of the flap are fitted into the defect. Note the relaxation incision on the neck.

portion previously implanted. This leaves a sinus opening into the mouth at the posterior edge.

THIRD STAGE.—Two or three weeks later the flap is opened at its point of reflexion (posterior margin) and, after preparation of the edge of the defect, the inner layer of the flap is sutured to mucous membrane and the outer to the skin. Several secondary shaping operations may be necessary.

Hahn's Operation.—This operation differs from that of Israel only in that the flap is obtained from the skin of the chest (down to the nipple) with its base at the clavicle. The head must be flexed and immobilized.



FIG. 679.—Operation for closing a cheek defect with flap from the shoulder (*Hacker*).—The flap from the shoulder is raised and sutured into the cheek defect, skin surface inward. The wound on the shoulder is partially closed by sutures. Two or three weeks later the pedicle is cut and may be used to cover the raw surface, or this area may be grafted.

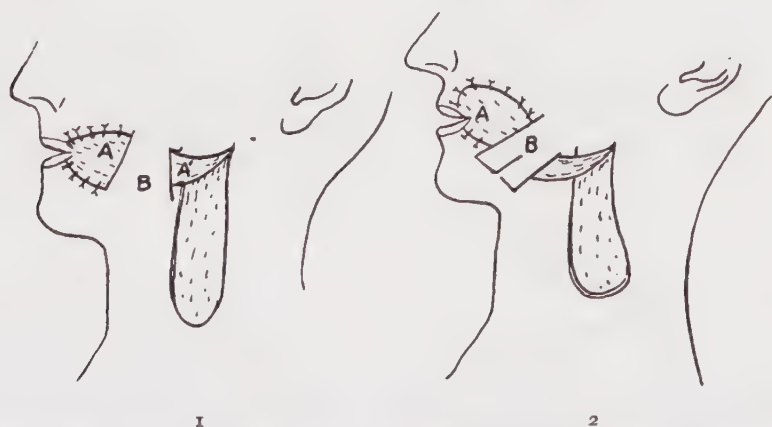


FIG. 680.—Restoration of cheek and angle of mouth (*v. Hacker*).—1. The scar divided from the angle of the mouth to the masseter, and the skin over the masseter undermined. The flap A from the neck is raised, passed under flap B, and after being notched is sutured into the defect to form angle of mouth, skin side inward. The neck wound is closed. 2. Two or three weeks later the lower attachment of the flap B is divided and split.

Von Hacker's Operations.—A number of methods of closing cheek defects have been suggested by von Hacker. He has used a pedunculated flap from the clavicular region (with its pedicle toward the

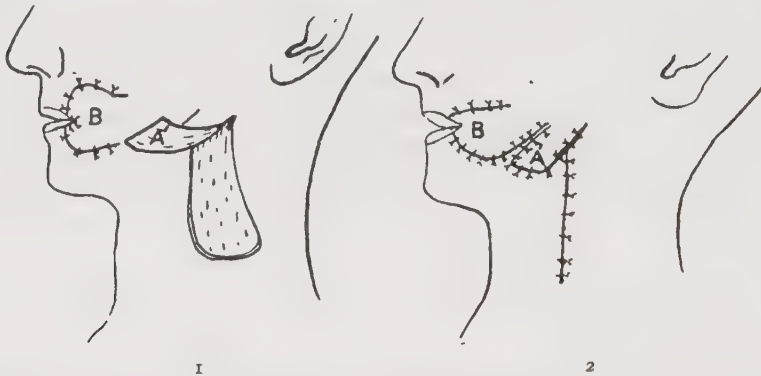


FIG. 681.—v. Hacker's operation for the restoration of cheek and angle of mouth, *continued*.—1. The flap A is divided across the posterior margin of the defect, and is sutured to place. The flap B is shifted to cover the raw surface and complete the angle of the mouth. 2. The pedicle A' is used to fill in the remaining raw surface.

midline), which is raised and sutured into the defect, skin surface inside. After two or three weeks the pedicle is cut and the raw surface may be closed by reflecting the pedicle end, or by grafting.



FIG. 682.—Operation to close a cheek defect (v. Hacker).—1. The flap A from the hairless portion of the neck is raised and inserted under the undermined skin B over the masseter, and is sutured into the cheek defect, skin surface inward. The wound on the neck is closed. 2. After two or three weeks the flap B is raised as shown. The flap is divided at the line C and is sutured into the defect, thus completely closing it.

Another method, also by von Hacker, is shown in the diagrams. A flap from the neck is raised, turned skin surface inward and passed under a bridge of normal skin, which lies between the pedicle and the

opening. The free end of the flap is sutured into the defect. In due time one end of the bridge of normal skin is cut, the pedicle of the flap is also cut, and the defect is completely closed. Then the pedicle end of the flap, and the bridge of the skin are utilized to cover the raw

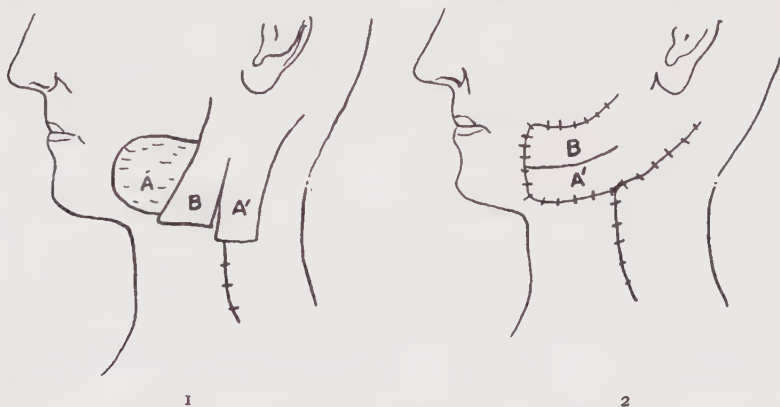


FIG. 683.—v. Hacker's operation to close a cheek defect, *continued*.—1. Flaps B and A' then mobilized and shifted forward to cover the raw surface A. 2. The flaps sutured.

surface of the implanted flap. The neck wound is sutured immediately after the flap has been raised. Several secondary operations are necessary to complete the work (Figs. 679-684).

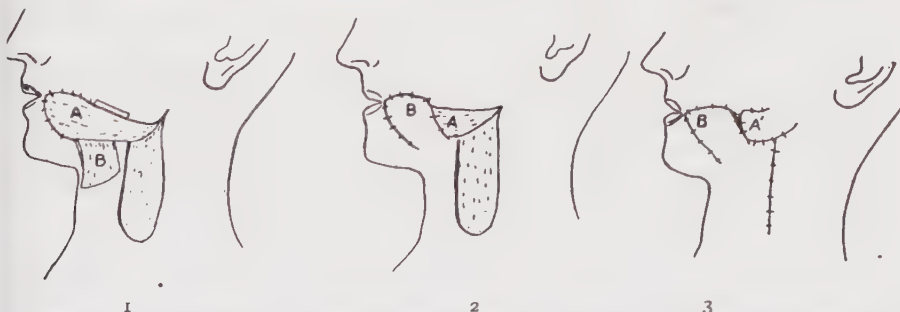


FIG. 684.—Operation to close a cheek defect (*v. Hacker*).—1. After the relief of contracture the flap A is raised from the neck and is sutured into the defect, skin side inward. The flap B may be shifted at once, or later, to cover the raw surface A. 2. Two or three weeks later the pedicle of the flap A is cut and fitted into the defect. 3. The defect completely closed.

Horsley's Operation.—Horsley lines the cheek defect with a flap turned up from the skin of the neck which is inserted (skin side inward) through an incision between the mandible and overlying soft part and is sutured to the edges of the mucous membrane. The raw surface of the flap is covered with a suitably shaped flap from the

orehead which has as its pedicle the anterior temporal artery, which is dissected out. When the flap is shifted, the artery is implanted into the soft parts in an incision made to receive it. This method is very similar to that used by Monks in forming an eyelid, described in a previous section. I can see no advantage in the transplantation of such a flap in cheek defects, as the mutilation and operative procedures are much greater than those belonging to simpler methods. Moreover, with properly made pedunculated flaps there is little difficulty in preserving adequate circulation.

Author's Method.¹—A patient had a severe attack of typhoid fever and was in bed for about ten weeks. While he was in a comatose condition a small ulcer appeared on the inside of the right cheek, which spread and finally went through its entire thickness. When he was admitted to the hospital I found a hole with a circular, funnel-shaped opening involving the entire thickness of the right cheek. The external diameter measured 6.25 cm. ($2\frac{1}{2}$ inches), the internal, 3.75 cm. ($1\frac{1}{2}$ inches). The defect extended from the level of the hard palate to the floor of the mouth, and from the ramus of the jaw to within half an inch of the angle of the mouth. The walls of the defect were made up of very dense scar tissue of woody hardness, which also involved the adjacent soft parts. Posteriorly, a thick column of scar tissue encroached upon the oral cavity, and this, with a smaller band anteriorly, bound the jaws together.

The mucosa of both the upper and the lower jaw on this side had evidently been implicated in the destructive process, and the alveolar processes were covered with dense scar tissue, which was continuous with the walls of the defect. The parotid duct could not be located. All the teeth were in bad condition on the right side, only one or two incisors being left. The tongue on this side was closely adherent to the body of the lower jaw along the floor of the defect to such an extent that only the tip could be moved. The patient was unable to open his mouth even with the greatest effort. This condition seemed to be due to the scar tissue and not to any trouble with the joints, as a certain amount of lateral joint movement could be demonstrated. Articulation was very indistinct, and talking was impossible unless the opening was plugged with a dressing. The patient was obliged to force his food with his finger back behind the teeth on the left side, and was unable to feed himself through the defect as the unequal movements of the tongue forced the food back through the opening.

¹ Davis, J. S.: "Anns. Surg.," March, 1913, 361.

For the repair of this large defect I decided upon a flap with a broad pedicle which would fulfil the following conditions: It must not contract appreciably after being implanted; it must have enough thickness to fill the defect without causing a depressed area after healing was complete; and it must be formed of soft tissue (preferably fat, with whole-thickness skin on both sides) which would conform in appearance to the surrounding skin externally, and take the place of the mucous membrane in the mouth. In order to avoid any further mutilation of the face or neck I determined to utilize the right arm.

OPERATION.—A large pedunculated, rectangular-shaped flap 7×16 cm. ($3 \times 6\frac{2}{5}$ inches), made up of whole-thickness skin with its subcutaneous fat, was raised from the outer side of the right arm, with its base in the mid-deltoid region. The flap was folded on itself, and the distal end sutured to the pedicle and underlying muscle with interrupted sutures placed at intervals in the edges, thus bringing raw surface to raw surface, and forming a flap with a double thickness of fat within, and with whole-thickness skin on the front and back. The flap was then stretched by means of four sutures on a gauze-covered wire frame, to keep it flat and to control contraction, and a number of small stab wounds were made in it to relieve congestion. The area from which the flap was raised was grafted immediately with Ollier-Thiersch grafts.

Fourteen days later as much as possible of the scar tissue was removed from the sides and upper portion of the defect. The tongue which was adherent almost to its base, was freed and drawn to the left side. Even after the scar tissue bands had been dissected out the jaws could not be opened to any extent, probably owing to the great infiltration of the muscles with scar tissue.

The flap on the arm was then opened across its free end, the edges were freshened, the arm was raised, and the flap was sutured into the defect with catgut in the mouth, and silk on the cheek. In this way the upper two-thirds of the defect was filled. The arm was then held in position by means of a plaster cast. The patient was placed on a Gatch bed. Water by rectum was commenced by the Murphy method and continued for several days. Only sterile water was given by the mouth, and nasal feeding was continued until the pedicle of the flap was amputated. Eleven days after implantation the cast was removed, and the pedicle was cut through, close to the arm. Eleven days later the scar tissue was removed from the lower third of the

defect and, after the edges had been trimmed and freshened, the flap was sutured so as to completely close the remainder of the opening.

By this means the defect was entirely closed with a thick flap with skin on both sides, which was nearly level with the surrounding tissues. There was a very marked improvement in the appearance of the patient. The flap was in excellent condition, and the skin was soft, pliable, and of normal color. Within the mouth the skin was pale and soft, and seemed to be gradually assuming the characteristics of the mucous membrane. The jaws could be opened so that the tip of the finger could be introduced between the incisor teeth, and there was quite a little lateral motion. There was free motion of the tongue,

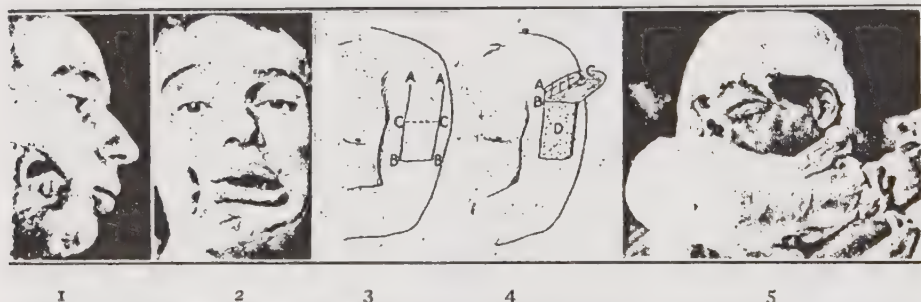


FIG. 685.—Cheek defect following noma (typhoid fever complication). Duration two years.—1. Note the depth of the posterior wall of the defect and the extent of the scar issue involvement around the opening. The tongue can be seen adherent to the lower portion of the defect. 2. Observe the position of the defect in regard to the angle of the mouth. The photograph shows the maximum separation of the jaws. 3 and 4. Schematic drawing showing the method of formation of the arm flap. 3. The outline of the flap having its pedicle AA above, and its free end at the line BB. The flap after being raised was folded on itself on the line CC. 4. The free end of the flap BB was sutured to the pedicle and underlying muscle at AA, and the edges are held together with sutures, thus forming a flap with a double thickness of fat within, and with whole-thickness skin on both sides. The area D was immediately grafted with Ollier-Thiersch grafts. The flap was stretched on a wire frame and after two weeks the free end along the line CC was split, the sides were freshened and the flap was implanted into the freshened edges of the defect. 5. The position of the arm and head in the plaster cast.

and the feeding process was simplified. Speech was much improved. The circulation of the flap had been assured, and most of the shrinkage had taken place before it was transplanted. There was no unsightly scarring of the cheek or neck, and the area from which the flap was raised had been entirely healed by means of Ollier-Thiersch grafts at the time the flap was ready for transplantation.

The only serious disadvantage of the method is the constrained position of the patient during the time the circulation from the cheek is entering the flap.

On the whole the result was satisfactory. There was still much

limitation of the jaw movement, but this was somewhat improved by subsequent removal of the condyle on that side. Furthermore, and most important, is the fact that the patient was relieved of a hideous deformity which would have prevented his living a comfortable healthy life, and would probably have interfered with his obtaining employment (Figs. 685-686).

Lauenstein's Operation.—A bridge of skin and subcutaneous tissue is raised from the midline over the sternum, the incisions being vertical. From one side on the same level is raised a hinged flap with pedicle close to the margin of the bridge and of sufficient size to cover the under surface of the bridge flap. This is turned over, drawn beneath the bridge flap, and held in position by sutures. The defect

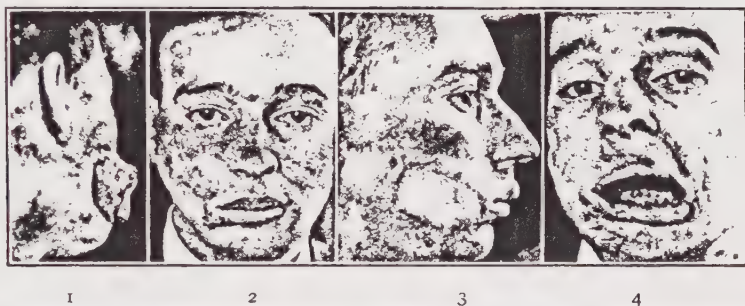


FIG. 686.—Cheek defect following noma, *continued*.—1. The pedicle was cut from the arm eleven days later. The photograph shows the flap nine days after cutting the pedicle and before fitting it into the lower portion of the defect. 2 and 3. Taken five years after implanting the flap. Note the scar left by the recent excision of the condyle. 4. Extent of jaw motion possible after the excision. The skin lining the cheek has assumed the appearance and the function of the mucous membrane.

left by the hinged flap is immediately grafted. After circulation has been established the pedicle is cut. Then the lateral incisions marking out the pedicle of the double faced flap are made, thus cutting off the lateral circulation. The pedicle is dissected up so that the circulation of the flap enters through the upper and lower attachments. Then the lower attachment is gradually severed, and the circulation enters entirely through the upper attachment. It takes a considerable time (39 days in Lauenstein's case) before the flap is shifted to the cheek defect. Two weeks later the pedicle is cut and sutured (Fig. 687).

This type of operation is a very valuable one. The gradual separation of the flap from its attachments assures the adjustment of circulation, so that by this seemingly slow process much time can be saved and there will be no sloughing after the flap has been shifted.

Lerda has used a rather heroic method of closing a large cheek

effect. He shifts the entire mouth toward the gap by means of horizontal incisions continuous with the upper and lower borders of the defect. These incisions extend through the full thickness of the

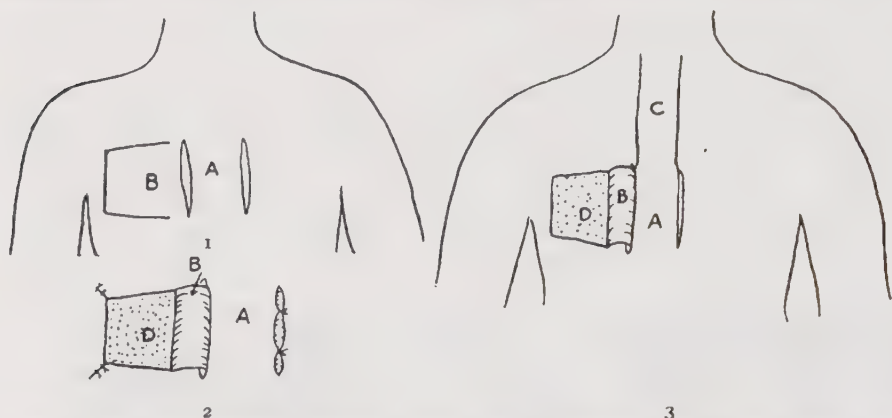


FIG. 687.—Operation for closing a cheek defect (*Lauenstein, Annals of Surgery, 1893, 7*).—1. A indicates the bridge flap which is undermined; B, the hinged flap which is to be drawn under A. 2. The flap B drawn under A and sutured; D, the raw area, which should be grafted. 3. Outline of pedicle C. The lower pedicle of flap A is gradually severed. The pedicle of flap B is cut, and the double-faced flap A is then shifted to the cheek.

lips and are carried across on the opposite cheek a sufficient distance to loosen the flap freely. Then the flap is shifted over and sutured to the margins of the defect in layers. The mouth is now much displaced, but after healing is complete it is returned to its central posi-

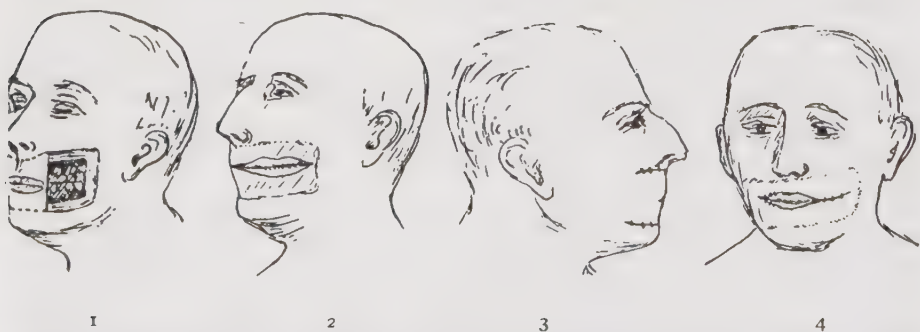


FIG. 688.—Operation for closing a cheek defect (*Lerda*).—1. The cheek defect. The incisions through the full thickness of the cheek are indicated by dotted lines. 2 and 3. Mouth and cheek of opposite side shifted over to fill the defect. 4. The defect closed and the mouth changed by shortening the angle on one side, and lengthening on the other.

tion by lengthening the angle away from, and shortening the angle nearest to the defect. This operation is not to be recommended, although it may be used occasionally (Fig. 688).

Bardenheuer's Operation.—This very mutilating procedure should be considered only in unusual and very extensive cases. Two flaps are taken, one from the forehead, with the pedicle above the eye, to line the cheek; the other, or covering flap, is taken from the side of the neck with the pedicle at the margin of the lower jaw. The flap which is utilized to replace the mucous membrane should be hairless. The pedicles are divided later, and secondary operations are done.

Monod and Vanverts' Operation.—An operation similar to that just mentioned utilizes a forehead flap cut in much the same way as

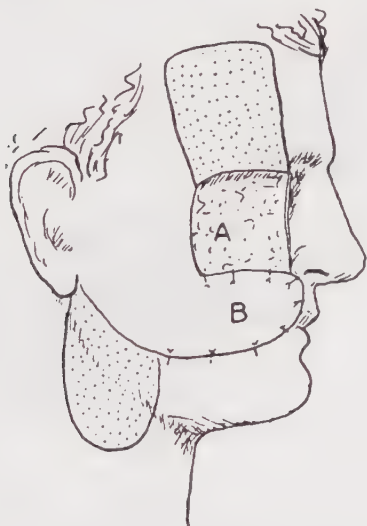


FIG. 689.



FIG. 690.

FIG. 689.—Bardenheuer's operation for closing a large cheek defect (*Binnie*).—The large flap A is turned down from the forehead to fill the defect, skin side inward, and the flap B from the neck is shifted up to cover it. The pedicles are cut later and turned back and all raw surfaces are grafted.

FIG. 690.—Monod and Vanverts' operation for closing a large cheek defect (*Binnie*).—The flap A from forehead, including the angular artery, is turned down and sutured into the defect, skin side inward. The flap B, from the neck is raised to cover it. Later the pedicles are cut and fitted in position. All raw surfaces are sutured or grafted.

for reconstruction of the nose, the pedicle of which contains the angular artery. The long pedicles of these flaps, after being severed, should be returned to their original position (Figs. 689-690).

Willard Bartlett in 1907 used the tongue for immediately closing a defect in the cheek following excision of a malignant growth of the mucous membrane. The greater portion of the mucous membrane, as well as a section of the full thickness of the cheek, was excised. The side of the tongue was split lengthways and the edges were sutured

to the margins of the defect. The superficial tissues of the cheek were closed. The mobility of the tongue is so great, that its usefulness was not impaired, and the patient could eat, talk and swallow without difficulty within two weeks. The teeth on the operated side (both upper and lower) were missing, and if this operation should be decided on it would be necessary to remove the teeth before utilizing the tongue. Practically the same operation was used by Meissl in 1906 for the same purpose (Fig. 691).

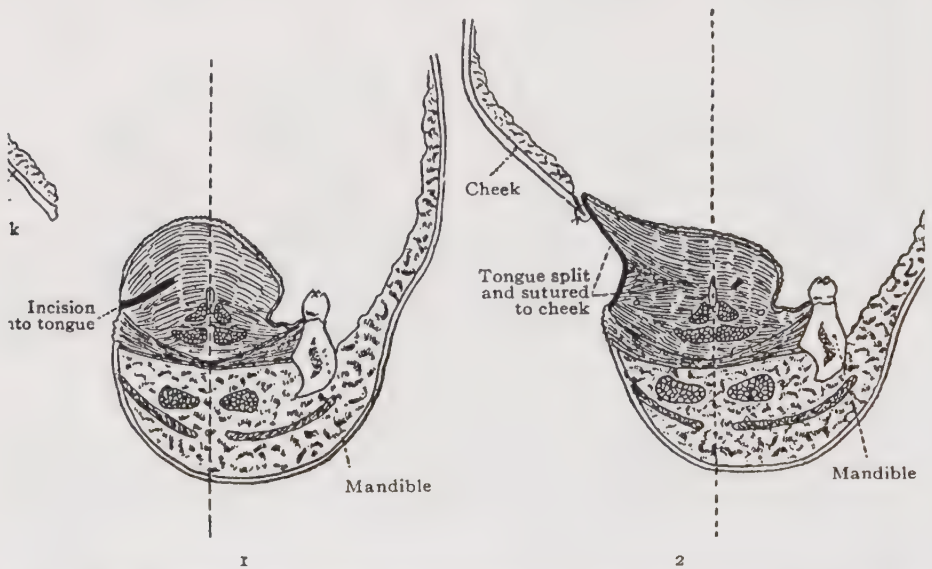


FIG. 691.—Operation for closing a cheek defect with the tongue (Meissl).—1. Frontal section through the mouth at the first malar tooth. The black line indicates the incision in the tongue parallel with the floor of the mouth. 2. The split tongue sutured to the margin of the cheek defect. The raw surface may be covered by a flap or by grafts.

CICATRICAL CONTRACTURE OF THE JAWS

In many old cases due to ulceration or extensive trauma, in addition to the cheek defect we have to contend with a locking of the jaws due to cicatricial contracture of the tissues of the cheek, and we are called upon to relieve the constriction and at the same time close the cheek defect. Such cases are very difficult and in many instances it is impossible to obtain more than a partial restoration of function. Hence, *it is much better to try to prevent the formation of the scar than to correct it after it is formed.*

Unless special contraindications exist in cases of extensive destruction of the tissues of the cheek, the formation of this contracture

can best be prevented by the "open bite" method of treatment; which should be insisted upon. The "open bite" splint with the smooth adjustable shield advocated by Cole is an excellent appliance. By its use the buccal sulcus is preserved, and when closure cannot be obtained the lips of the wound are prevented from prolapse, and the contour is preserved. Much can be accomplished by keeping the jaws apart, but unfortunately it is seldom that we see these cases until the contracture has taken place, and the condition has existed for years.

Among operations devised for relieving the contracture and at the same time lining the cheek, the following may be mentioned

Gussenbauer's Operation.—This operation is applicable in case of comparatively small cheek defects with locking of the jaws due to scar tissue. It is done in stages.

FIRST STAGE.—A quadrilateral flap of the skin of the cheek (of the desired width) extending from the angle of the mouth to the mas-



FIG. 692.—Operation for lining the cheek, and closing a cheek defect (*Gussenbauer*).—The flap X is raised from the cheek with its pedicle at the anterior border of the masseter muscle. The scar tissue is divided from the angle of the mouth to the edge of the masseter. 2. The free end of the flap turned in and sutured into the defect at the inner margin of the masseter.

seter muscle is dissected up. Its free end is in front, and its pedicle at the anterior border of the masseter. The cicatricial tissue beneath is divided from the angle of the mouth to the masseter, and the mouth is opened; the flap is folded, skin surface inward, and the anterior border is sutured to the mucous membrane at the edge of the masseter.

SECOND STAGE.—Four weeks later the pedicle is cut; the external surface (pedicle end) is turned inward to complete the lining of the cheek, and is sutured in position.

THIRD STAGE.—The external raw surface of the flap may be covered by shifting skin from the border of the lower jaw, or in any way deemed advisable for the special case. Secondary operation will be necessary (Figs. 692–693).

Nélaton and Ombrédanne's Operation. FIRST STAGE.—Excise with horizontal incisions the scar tissue on the affected side from the angle of the mouth to the masseter muscle. A flap of the required



FIG. 693.—Operation for lining the cheek, *continued*.—1. Two weeks later the pedicle of the flap is cut and the outer portion is unfolded and turned in to line the anterior part of the cheek. 2. A flap with pedicle adjacent to the defect is raised, and shifted to cover the raw surface. Skin defects are sutured.

size is raised from the inner side of the arm with its pedicle below; this is sutured to the defect in the mucosa, skin side inward, and the arm is immobilized.



FIG. 694.—Operation for lining a cheek defect (modified from Nélaton and Ombrédanne.).—1. The defect is lined by a flap X, from the arm, pedicle below. 2. After two weeks the pedicle Y is lengthened and cut, and turned outward to cover the raw surface of the portion of the flap first implanted. This may be done on both sides, if necessary.

SECOND STAGE.—Three weeks later the pedicle of the flap on the arm is lengthened so that when it is cut it can be folded over to cover the raw surface of the portion first inserted. It is then sutured into

position. The other side may be treated in a similar manner. Secondary trimming operations will be necessary. The arm defect may be sutured or grafted (Fig. 694).

I have seen cases in which the jaws were locked so tightly that the teeth were pushed outward and buried in the mass of scar which had fused the cheek and jaws into one solid immovable piece. In these cases an effort must be made to separate the cheek from the alveolar processes; then to line the cheek and gradually, after several operations to loosen the jaw. Sometimes in these cases excision of the head of the bone may be of service, but this alone does not give much relief. It may be used in connection with the operation of *Le Dentu*, in which the insertion of the masseter and the internal pterygoid muscles are loosened from the mandible with excision of as much scar tissue as possible, and the destroyed mucous membrane is replaced by whole-thickness skin flaps. The excision of a wedge of bone on each side of the mandible in front of the scar bands, as advised by Esmarch for the relief of complete ankylosis, has little to recommend it, although it may be tried as a last resort.

Stretching the Scar Tissue.—Many forms of apparatus have been devised for stretching scar tissue constricting the jaws, but unless the scar is scanty, little can be accomplished by this method. However after division of the scar, as suggested by Mott, stretching may be effective, if continued for a considerable period.

Angiomata

Angiomata of the cheek or lips may be treated by methods already described in the section on this subject.

Depressed Scars

The various methods of treating ordinary scars have been previously described. In the extensive depressed scars of the cheek following wounds, much can be done after the scar has been excised and normal skin has been sutured to normal skin, by the transplantation of fat to fill out the depression. If the depression is in the region of the zygomatic arch, a pedunculated flap of the temporal muscle may be shifted down to fill it. Sometimes free or decalcified bone, implanted in the soft parts may be used to fill in the depression.

Piéri has used with success pedunculated flaps of fat (after Mouro

method) to fill out defects in the face. According to the situation of the depression to be filled, he obtains the fat from the chin, between the buccinator and masseter muscles, or from the zygomatic fossa. I have used this method with much success.

SALIVARY FISTULÆ

Salivary fistulæ are quite rare in civil practice, but sometimes they are of interest to the plastic surgeon as a complication in the treatment of old cheek defects. Considering the frequency of face wounds in this war they are fairly uncommon, although Morestin reports 30 cases of the glandular type, and 32 cases of fistulæ of Stenson's duct that have come under his care between 1915 and 1917.

These fistulæ, in the vast majority of cases, are connected with the parotid gland or its duct, and may be divided into two groups: (1) *Glandular fistulæ*. (2) *Fistulæ of Stenson's duct*.

A clean incised wound into the parotid gland will usually heal spontaneously, but little can be done to avoid the occurrence of fistulæ in war wounds of the parotid, because they are so frequently complicated by infection. The condition is usually well established and the diagnosis clear by the time the patient is referred to the plastic surgeon.

In all recent wounds involving the cheek, if Stenson's duct can be located it should be immediately fixed in position, so that it will discharge into the mouth.

Glandular fistulæ may occur anywhere over the parotid gland, those in the upper or lower portion being much less difficult to cure than those opening into the main collecting channels which are situated at the junction of the upper and middle thirds close to the anterior border. In operating on fistulæ every effort should be made to avoid injury to branches of the facial nerve and the larger vessels.

Treatment of Glandular Fistulæ.—Immobilization of the jaws has been recommended, and Piétri reports 38 cases cured by this method. The jaws are held together sometimes for several months with intermaxillary ligatures, splints, or by means of a bandage which prevents the jaws being opened. Liquid nourishment is given and speaking is prohibited. As the fistula closes the diet is gradually increased.

Dieulafé says that many cases will heal spontaneously without immobilization of the jaws, and that the fistula persists just as often in those who have been subjected to immobilization as in those who have

not had the jaws closed. Be that as it may, since the method is simple, it should be tried in conjunction with cauterization.

Glandular fistulæ may be treated by cauterization with silver nitrate or, better still, with the actual cautery. The cautery may be applied directly to the fistulous tract every few days, or the application may be made through a small incision above and below the fistula until the tract is removed and the wound closed.

Extensive avulsion of the auriculo-temporal nerve (which is found between the temporal artery and the ear) may be done for the purpose of diminishing the secretion of the gland, and a number of good



FIG. 695.—Hemangioma of the cheek.—1 and 2. Before operative interference. The growth extended from the ear to the midline of the lip. The lower lid and side of the nose and also the mucous membrane of the mouth on the right side were involved. 3. Photograph taken six weeks later. 4. Taken four months after the first operation. There has been considerable improvement. Several further operations will have to be done. The bones on the right side of the face are also markedly hypertrophied and the necessary portions will have to be removed before symmetry can be brought about. Little could be accomplished by injections in this case as there is considerable fibrous tissue scattered through the growth.

results have been reported by this method (Leriche, Deupes, Dieulafoy, Tromp, Ianni, and others).

The fistulous tract may be excised, and the wound carefully closed in layers, so as to leave no dead space. Morestin found that 24 of the 26 cases treated by this method healed without complication and considers extirpation the method of choice. In one case fluid collected in the wound; this was aspirated, whenever necessary, and pressure applied. The wound healed promptly. In the other case infection occurred but the final result was good. In the cases following war wounds in which the fistula is in the midst of dense scar tissue (adherent and depressed), it is important that all the scar be removed. In these the cure of the fistula can be accomplished as an incident.

he operations for removing the disfiguring scar tissue. Sometimes it may be necessary to extirpate the entire gland, but this should not be done until all other methods have failed.

Submaxillary glandular fistulæ are very rare as compared with those of the parotid. For these extirpation is the operation of choice.

Fistulæ of Stenson's Duct.—Dieulafoy has found three forms following war wounds. (1) Fistulæ caused by lateral section of the duct, with limited traumatism of the cheek. (2) Fistulæ caused by great destruction of the cheek, followed by contracted scars which occlude the duct, obliterating its normal orifice and leaving open the skin wound. This is the most common variety. (3) Fistulæ of the duct caused by infection associated with destructive traumatism involving bone and soft parts.

Many operations have been devised for the relief of this condition. The object of these operations is to divert the flow of parotid secretion into the mouth from its abnormal external point of discharge. If this cannot be done by any of the means at our command, it may be deemed advisable to check the secretion entirely.

Operations for the relief of fistulæ of Stenson's duct vary with the position of the fistula; (1) when it is anterior to the masseter muscle; (2) when it is in the masseteric portion of the duct.

1. When the Fistula is Anterior to the Masseter Muscle

Von Langenbeck's Operation.—A probe is passed through the fistula into the portion of the duct next to the gland. The duct having been dissected out its free end is drawn through an opening into the mouth, and sutured to the buccal mucosa. The external wound is closed. This is the operation of choice when the duct is anterior to the masseter, but unfortunately the fistulæ are usually found much further back.

Deguisse's Operation.—From the fistula make two perforations 5.625 cm. ($\frac{1}{4}$ inch) apart into the mouth. Pass through these perforations an elastic ligature, a silver or lead wire, or a silk ligature, and



FIG. 696.—Operation for fistula of Stenson's duct (*Deguisse*).—A wire or rubber ligature is inserted from the buccal surface so that it passes through the floor of the fistula. It is tied or twisted tightly, and the tissue included will slough, thus making an opening into the mouth. The fistulous tract is then excised and the edges are closed.

tie snugly inside the mouth. The tissue included in this ligature will necrose, and a permanent opening will result. When this is assured excise the fistulous tract in the skin, and close the external wound (Fig. 696).

Kaufmann's Operation.—Thrust a cannula about 0.312 cm. ($\frac{1}{8}$ inch) in diameter through the fistula into the mouth, and through it pass a rubber tube or a seton. Remove the cannula and, after the tract around the tube has been covered with epithelium, freshen the skin edges and close the external wound.

2. When the Fistula is Situated in the Masseteric Portion of Stenson's Duct

Von Langenbeck's operation may be used if the duct is long enough and can be brought through a transverse incision in the masseter to the buccal mucous membrane. The methods of Kaufmann and Deguise may also be used, but the masseter should not be punctured and the seton, stitch, or rubber drain should be passed through a tunnel burrowed between the masseter and the skin.

Braun's, or Küttner's Operation.—A new duct is formed with a pedunculated flap from the buccal mucosa. Through a skin incision a flap of mucous membrane of sufficient length to bridge the defect without tension is raised in front of the masseter, with its pedicle at the anterior border of this muscle. It is turned back over the edge of the masseter, its free end is sutured to the stump of the duct, which has been freely mobilized, and the edges of the flap are brought together to form a sort of tube. The skin is then closed. This operation is said to be effective (Fig. 697).

Crouse's Operation.—A vertical incision 3. cm. ($1\frac{1}{8}$ inch) long is made through skin and fat, 2. cm. ($\frac{4}{5}$ inch) below the zygomatic process, and 2. cm. ($\frac{4}{5}$ inch) in front of the ear. This incision avoids injuring nerves and vessels. The parotid fascia is exposed, and an incision 1. cm. ($\frac{2}{5}$ inch) long is made in it. The cheek is then everted and a pedunculated flap of buccal mucous membrane 0.625 cm. ($\frac{1}{2}$ inch) wide (I would suggest a slightly wider flap), and 0.312 cm. ($\frac{1}{8}$ inch) thick, is raised. The free end should be close to the vermilion line of the upper lip, and the base opposite the cusp of the second upper molar tooth. Then with a curved clamp a tunnel is burrowed between the skin and the masseter muscle, the clamp is passed over the anterior border of the masseter, punctures the buccinator, and enters

the mouth just in front of the base of the pedunculated mucous membrane flap. The flap is then drawn through this tunnel, and its tip is sutured into the incision in the parotid fascia with a modified Lembert suture of No. 0, 10-day chromic catgut, which pulls it in.

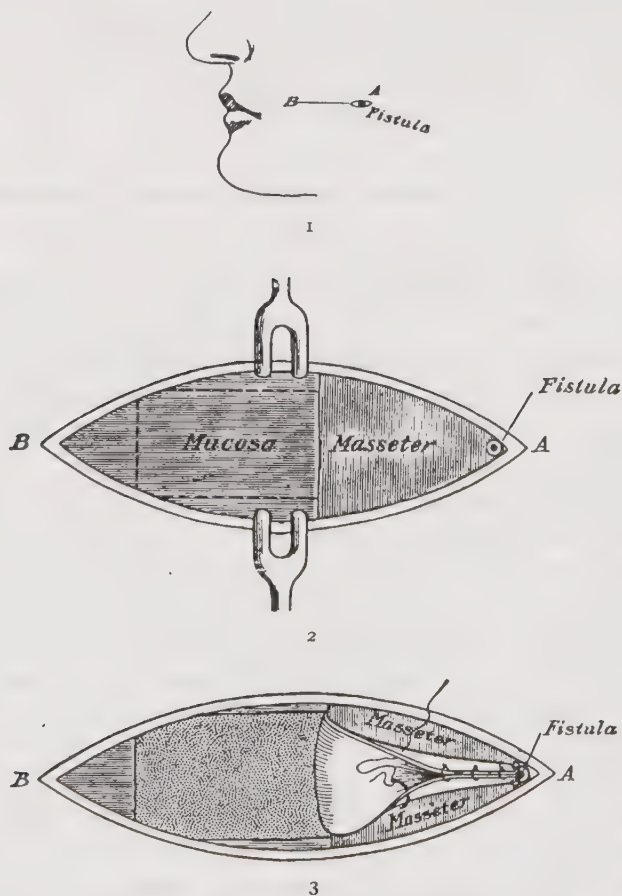


FIG. 697.—Braun's operation for fistula of Stenson's duct (Binnie).—1. Make the incision *AB* which divides all the tissues except the masseter, and the buccal mucosa. Dissect the fistulous opening free from the skin. 2. Retract the tissues and form a flap of mucosa of the desired length and width, with its pedicle at the anterior border of the masseter. 3. Turn the flap back and suture its free end to the fistula, and its edges together to form a tube. Close the skin wound.

The ends of this suture are left long, and to it is tied a loop of No. 5, 10-day chromic catgut which is passed in from the mouth along the flap (the ends being left in the mouth). The mucous flap assumes a channel-like form, and it may be wise to draw the edges together with a stitch or two, in order to form a sort of tube over the catgut strands.

This is an excellent operation and with modifications is well worth trying (Figs. 698-699).

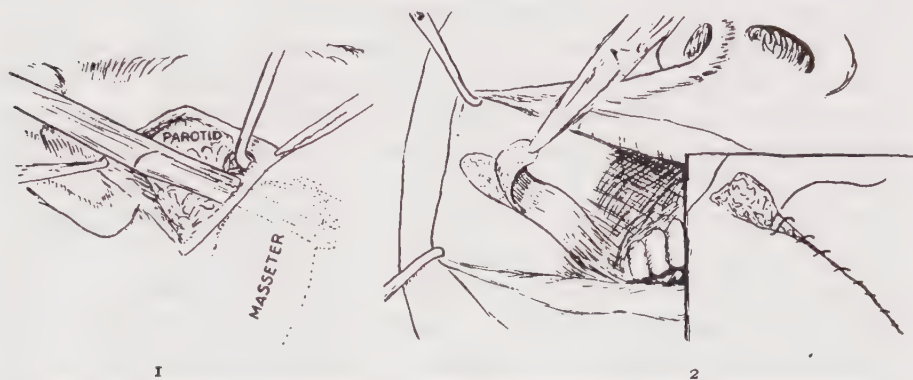


FIG. 698.—Operation for fistula of Stenson's duct (*Crouse*).—1. The skin is retracted and the fascia over the parotid is exposed. Note the clamp which is passed beneath the skin and over the anterior margin of the masseter muscle. 2. The cheek turned out as a thick flap of mucous membrane and submucous tissue is raised, its pedicle being opposite the second molar tooth. The insert shows the closure of the mucous membrane.

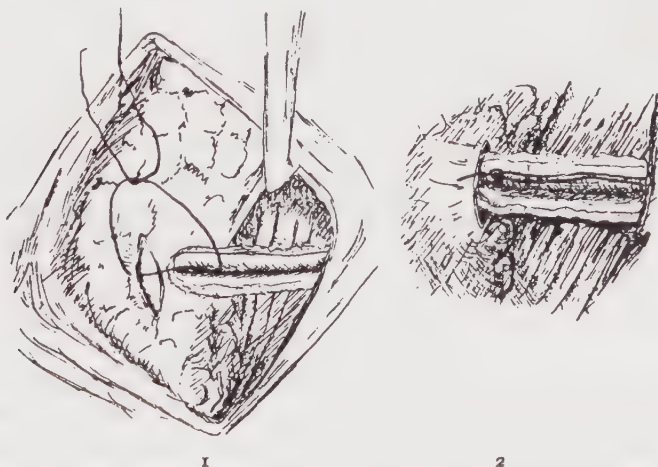


FIG. 699.—Operation for fistula of Stenson's duct, *continued*. 1. The mucous flap drawn through the tunnel made by the clamp. Note the modified Lembert suture which will draw the tip of the flap under the edge of the slit in the parotid fascia. Note the gutter shape assumed by the flap. 2. The loop of ten-day catgut lying in the bottom of the gutter is tied to the Lembert suture. A few sutures placed in the margins of the flap will tend to form a tube.

Anastomosis Between the Parotid and Submaxillary Glands.—

Ferrarini's suggestion of forming an anastomosis between glandular portions of the parotid and submaxillary glands in cases of fistula of Stenson's duct does not appear to be practical. The restoration of

the duct by means of a segment of vein, or by a skin graft, has also been tried, but these methods cannot be commended.

It has been known for some time that when Stenson's duct has been obliterated by scar tissue close to the gland the gland will atrophy, and this probably occurs after healing in extensive wounds more frequently than we have realized. The secretion that pours out of the fistula is, of course, lost as far as digestive processes are concerned, although this loss causes no perceptible disadvantage to the patient. Morestin, noting this fact, in treating his cases of fistulæ of Stenson's duct in which there was no possibility of successful implantation on the buccal surface, dissects out the stump of the duct with all the surrounding tissue, ligates it at its origin, after which he mobilizes the soft parts and closes without drainage. The obliteration of the duct causes rapid physiological death of the gland, but the patient is no worse off than when the secretion was being discharged upon the cheek. Morestin is enthusiastic over the method, and out of 32 cases of fistulæ of Stenson's duct in war wounds treated 16 by the establishment of drainage into the buccal cavity, and 13 by ligating the duct close to the gland. (The remaining 3 cases were done by other methods.) His experience has led him to conclude that the latter method is the best, and he has decided to use it exclusively in all suitable cases.

Although supported by various authors, one would hardly feel justified in avulsing the auriculo-temporal nerve, or in extirpating the parotid gland for the cure of a fistula of Stenson's duct when simpler methods will accomplish the same purpose.

FACIAL PARALYSIS

The cases of facial paralysis which come to the plastic surgeon are either those of very long standing, those in which nerve anastomosis (facial to spinal accessory, or facial to hypoglossal) has been unsuccessful, or those in which the extent of the destruction has precluded nerve anastomosis.

The technic of nerve anastomosis, which is, of course, the method of choice when practical, will not be considered here; for full details of the method the reader is referred to the following articles:¹

¹BALLANCE, C. H., BALLANCE, H. A., & STEWART, P. "Brit. Med. Jour.," 1903, i, 1009.

BALLANCE, C. H. "Lancet." London, June 12, 1909, 1675.

BECKMAN, E. H. "Michigan State Med. Soc. Jour.," Dec., 1914.

CUSHING, H. "Anns. Surg.," May, 1903, 641.

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The paralysis may be due to any cause (injury or disease) by which the continuity of the nerve is broken. The muscles are atrophied and flabby and no longer respond to the faradic current; the angle of the mouth droops and there is constant drooling of saliva; the mucous membrane of the cheek is frequently caught between the teeth; speech may be impaired on account of the lack of control of the lips; the lower eyelid is everted; conjunctivitis is chronic, and lachrymation is continuous.



FIG. 700.—Myeloplasty for facial paralysis (*Eden*).—Schematic drawing showing the skin incisions A in the hair line, and B in the nasolabial fold. D, the temporal muscle. D', a pedunculated flap of the temporal muscle attached to the orbicularis palpebrarum. C, the masseter muscle. C', a flap of the masseter split and attached above and below the angles of the mouth.

The facial nerve may be accidentally cut, or a section of it be excised during operations for removal of glands of the neck and quite a number of such cases have come under my observation years after the accident. The patients, of course, desire improvement in their appearance, but many of these patients have become more or less accustomed to their deformity and simply desire the angle of the mouth to be raised to overcome drooling, and the lower eyelid adjusted for the protection of the eye. It is needless to say that if these two defects can be remedied the appearance is also much improved.

ELEVATION OF LOWER EYELID

The eyelid may be raised by one of the plastic operations already described for the relief of ectropion, or by means of a pedunculated flap from the temporal muscle.

Operation for Raising the Lower Eyelid by the Attachment of a Pedunculated Flap of the Temporal Muscle to the Orbicularis Palpebrarum (Modified after Lexer and Morestin).—A curved incision about 7. cm. ($2\frac{4}{5}$ inches) long is made along the anterior border of the temporal fossa; a bundle of fibers is separated from the tempora

FRAZIER & SPILLER. "Univ. of Penn. Med. Bull.," 1903.

GRANT, W. W. "Jour. Amer. Med. Assn.," Oct. 22, 1910, 1438.

ROTHSCHILD, O. "Centralbl. f. d. Grenzgebiete d. Med. u. Chir.," Dec. 21, 1911, 823.

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muscle with its pedicle above. The orbicularis palpebrarum is found and the muscle flap is sutured to it at the angle, or along the lower lid, in such a manner as to raise the lower lid. The wound is then closed (Fig. 700).

ELEVATION OF ANGLE OF MOUTH

A number of ingenious operations have been devised for raising the angle of the mouth, some of which are quite satisfactory.

The angle may be raised to the desired position with a strip of free fascia lata (Stein, and others); with thin wire (Busch, Momburg, and others); or silk looped over the zygomatic arch. This may also be accomplished by implanting the end of a living muscle (the sternocleidomastoid, J. Jianu, Gomoiu, Hildebrand, and others; the masseter, A. Jianu, Jonnescu, Lexer, and others; or the digastric, J. Jianu), into the orbicularis oris at the angle of the mouth. Morestin sutures the buccinator muscle to the anterior border and aponeurosis of the masseter muscle.

RAISING THE ANGLE OF THE MOUTH IN FACIAL PARALYSIS BY MYELOPLASTY

The Use of a Pedunculated Flap of the Sternocleidomastoid Muscle.

—The upper portion of the sternocleidomastoid is exposed and a flap is raised from its anterior border, base upward. Through the same incision a tunnel is burrowed to the orbicularis oris muscle, and through a small skin incision close to the angle of the mouth the end of the muscle flap is drawn through the tunnel and sutured into position. The skin incisions are then closed. The posterior belly of the digastric muscle has been used for the same purpose in much the same manner.

The Use of a Pedunculated Flap of the Anterior Portion of the Masseter Muscle (A. Jianu).—The use of a muscle flap from the masseter muscle is much simpler, and seems to me more rational. (The masseter is supplied by the masseteric branch of the fifth nerve.) The masseter muscle is exposed through a curved incision following the edge of the inferior maxilla, and its anterior portion is separated from the bone as a flap with its pedicle above. The skin is retracted, undermined if necessary, and the flap in one piece is sutured to the orbicularis oris at the angle of the mouth or, if split, is sutured above and below. The skin is closed (Figs. 701-702).

Lexer approaches the masseter through an incision in the naso-

labial fold; he raises a flap similar to that just described, and insert it in the same manner.

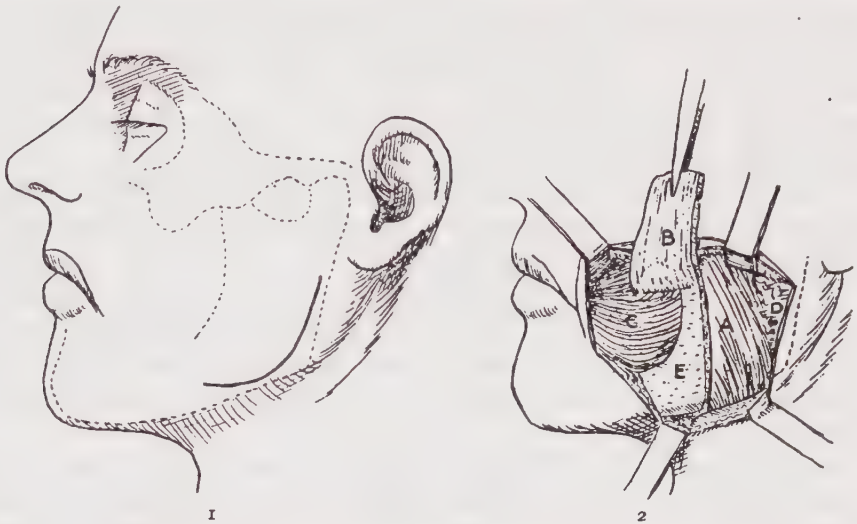


FIG. 701.—Operation for raising the angle of the mouth in facial paralysis by the use of a pedunculated flap of the masseter muscle (*A. Jianu*).—1. Dotted lines represent the outline of the inferior maxilla. The solid line indicates the curved incision. 2. A, the portion of the masseter muscle still attached to the bone. B, the flap of the anterior portion of the masseter. C, the buccinator muscle. D, the parotid gland. E, the inferior maxilla.

The muscle flap operations are extremely useful and offer a chance of improvement together with movement of the mouth, to patients on whom nerve anastomosis has failed.

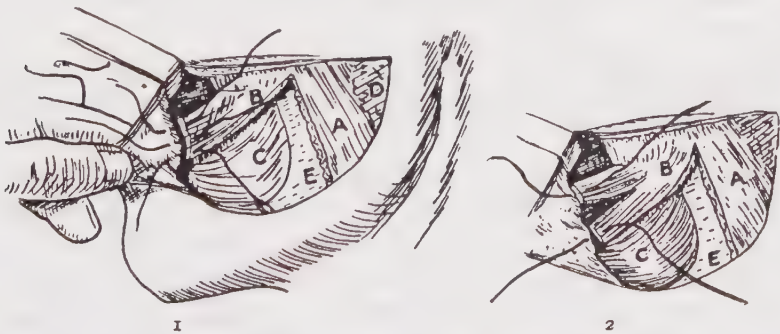


FIG. 702.—A. Jianu's operation for utilizing a flap of the masseter muscle, *continued*.—1. A single flap B sutured into the angle of the mouth. 2. The flap B split and sutured above and below the angle of the mouth.

When the living muscle flap is used, the associated movements may be objectionable, but with training the lip may be moved and even the facial expression may be obtained.

Morestin's Operation.—Through an incision 5. cm. (2 inches) long under the angle of the jaw, the anterior portion of the masseter muscle is exposed. The buccinator muscle is found and shortened with sutures. It is then fastened to the anterior border and external face of the masseter by sutures placed to raise the angle of the mouth to the desired position.

Morestin claims to have had good results with this method. Before performing this operation it must be borne in mind that the buccinator muscle is supplied by the facial nerve.

My own preference is for a flap of the masseter muscle, or for the use of the buccinator rather than for the flap from the sternocleidomastoid or digastric muscles, as the direction of pull is too low with the last two mentioned. If the myeloplastic operations fail, we have the simpler methods which follow.

Stein's Operation. *Transplantation of Free Fascia.*—Three weeks before transplantation a small amount of paraffin is injected near the angle of the mouth, in order to prepare a firm hold for the fascia. Then a strip of fascia lata 20. cm. (8 inches) long by 2. cm. ($\frac{4}{5}$ inch) broad, is removed. Through an incision over the malar bone a tunnel is burrowed down to the angle of the mouth. A small incision is then made near the angle and the loop of fascia is passed around the paraffin injected tissue. After the angle has been raised to the desired position, the ends are sutured around the zygomatic arch; the wounds are then closed. The fascia does not stretch and will live when transplanted.

By this method, which with modifications is a good one, much can be accomplished. A single strip of fascia may also be used with satisfaction.

Momburg's Operation. (*The Modified Busch Operation.*)—Through an incision along its lower border the malar bone is exposed; a second incision is made parallel to the mouth, just above the angle, and a thin aluminium bronze wire is passed through the cheek tissues, with a special needle, from above downward. A broad hold having been taken near the mouth, the wire is returned through the tissues of the cheek and is passed around the zygomatic arch, where it is secured after the lip has been raised to the desired height (Fig. 703).

This differs from the Busch operation in that the wire is passed around the malar bone, instead of through a hole bored in it, and the amount of tissue included in the loop at the angle of the mouth is

greater. The same operation may be done with waxed silk, which is more flexible.

By the use of fascia, wire, or silk, the angle of the mouth can be raised as described, and the drooling controlled, but there will be no motion.

In all of the old cases there is a great deal of lax skin, and I have found it advisable to remove suitable areas of it, in addition to the radical procedures.

It is well to realize that the skin of old cases of facial paralysis tends to stretch and has little power of resisting infection. The scar after healing, is apparently prone to stretch much more than a scar in normal skin.

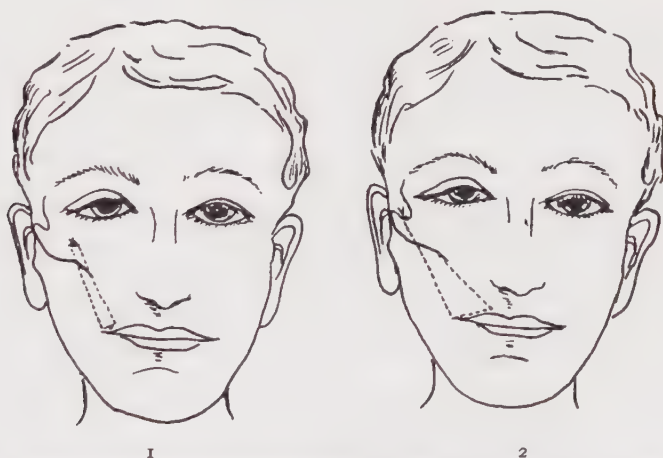


FIG. 703.—The use of a wire loop for raising the angle of the mouth in facial paralysis. —1. The position of the wire passed through a perforation in the zygomatic arch (*Busch*). 2. The position of the wire passed over the zygomatic arch (*Momburg*).

In all of these methods where tunnelling through the tissues of the cheek is necessary, it is advisable to place the fingers inside the mouth, so that the progress of the tunnelling instrument may be followed and perforation of the mucous membrane avoided.

Läwen has implanted pieces of free bone into both upper and lower lips to hold them in position in cases of congenital facial paralysis. I do not consider this method of any special value, but if the procedure is used cartilage should be implanted and not bone.

After these operations the part should be kept absolutely quiet until healing is complete. Liquid diet should be given for at least two weeks.

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CHAPTER XXIII

SURGERY OF THE NECK, TRUNK, AND EXTREMITIES

GENERAL CONSIDERATIONS

Plastic surgery of the neck, trunk and extremities, is certainly of sufficient importance to warrant more attention than has hitherto been paid to this branch of the subject. Thus far most of the general articles on plastic surgery make no mention of this field, except as a source of supply for flaps or grafts with which to repair defects of the face. It must be remembered, however, that many deformities absolutely incapacitate the patient, and, unless promptly relieved often cause permanent distortion of the underlying bony framework. Undoubtedly among the most difficult problems which confront the plastic surgeon are those presented by the extraordinarily varied contractures which occur in these regions.

The majority of these deformities have been caused by the contracture of scar following burns or extensive surface wounds. Fortunately the scar is generally in the skin and subcutaneous tissues, but occasionally the deeper structures are implicated. In cases of longstanding contracture (especially when in flexion) muscles and anterior joint ligaments will be shortened, the growth of bone will be interfered with, the shape of articulating surfaces will be changed, and in many instances the contour of the bone itself will be markedly distorted. For example, this may often be seen when the alveolar margin of the mandible is turned outward in extensive contracture of the neck, and in the bowing of the bones of an extremity toward rigid scar extending along its full length. Not a few of these contractures are found in children.

Much can be accomplished in burns or extensive loss of skin of the neck, and around joints to prevent contracture during the treatment of the wound by early over-correction of the part, and keeping it in an over-corrected position during healing. Healing should be accelerated in every way, and especially by skin grafting. In this way contractures may to a large extent be avoided, and if one does occur after such precautions the relief of it is a minor matter when compared to that of the more extensive variety.

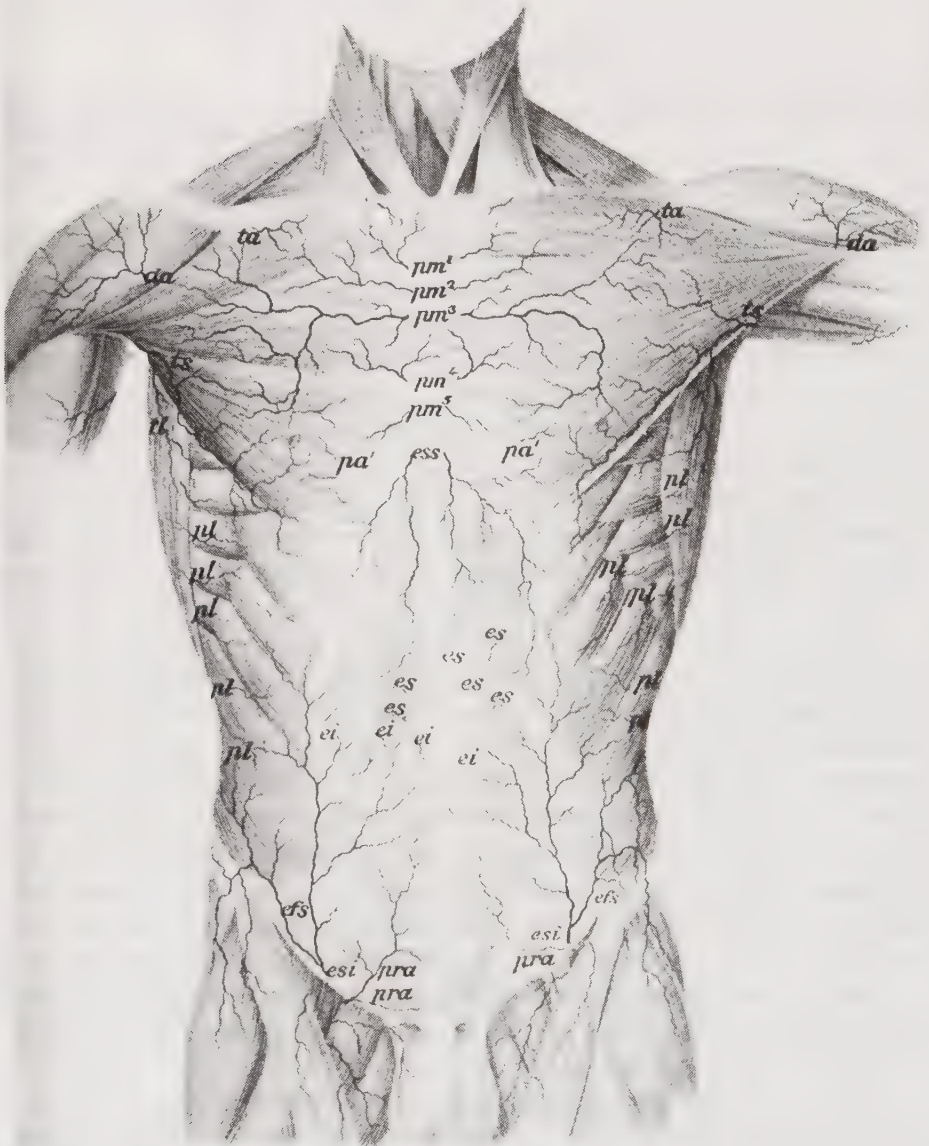


FIG. 704.—Arteries of the skin of the front of the trunk (Manhot).—*tl*. Long thoracic artery. *ts*. Superficial thoracic artery. *ta*. Thoracic branch of the acromial-thoracic artery. *pm*. Perforating branches of the internal mammary artery. *pm'*, *pm''*, *pm'''*. Perforating branches of the intercostal arteries. *da*. Anterior circumflex artery. *pa'*. Perforating branches of the anterior intercostal arteries. *pl*. Lateral perforating branches of the intercostal and lumbar arteries. *ess*. Superior superficial epigastric artery. *esi*. Inferior superficial epigastric artery. *es*. Cutaneous branches of the superior epigastric artery. *ei*. Cutaneous branches of the inferior epigastric artery. *pra*. Abdominal branch of the superficial external pudic artery (superior). *efs*. Superficial circumflex iliac artery.

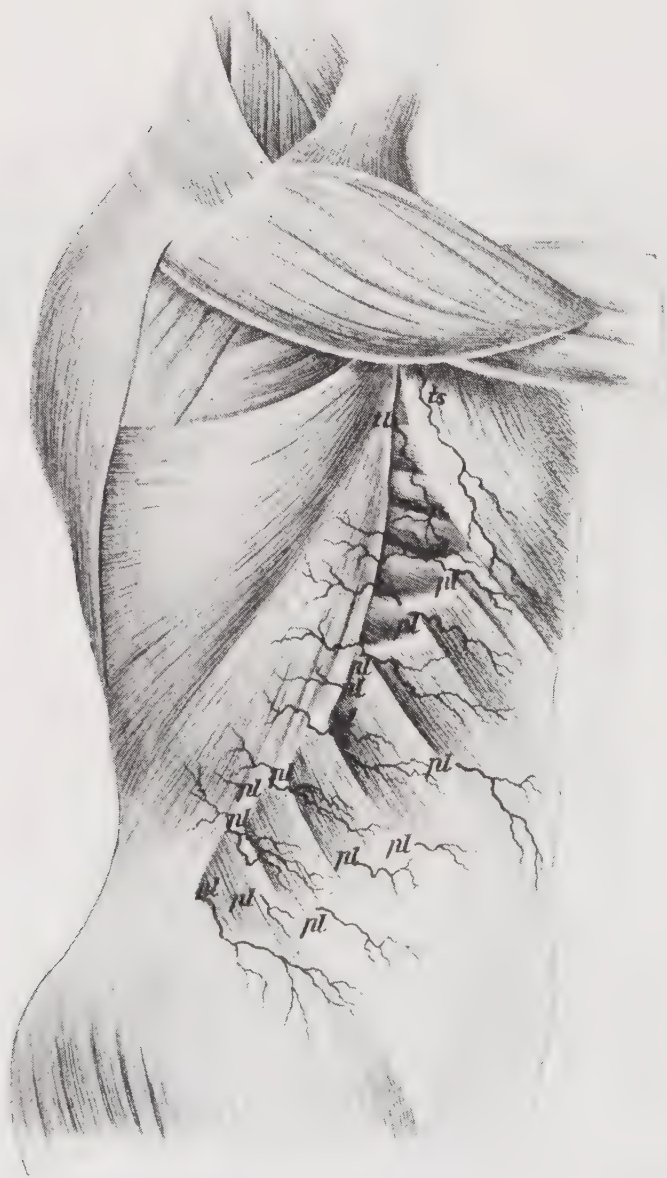


FIG. 706.—Arteries of the skin of the side of the trunk (*Manchol*).—*ts*. Superficial thoracic artery. *pl*. Lateral perforating branches of the intercostal and lumbar arteries.

In some instances a burn may be so serious that little is thought of except saving the life of the patient, and even if later the general condition improves sufficiently to allow of over-correction, it may then be impossible.

Sometimes the contracture is surrounded by skin, which is normal or nearly so, but in the great majority of cases there is a wide zone of scar tissue surrounding the contracture, or even the entire part may be covered with scar. In such cases the problem of obtaining flaps of normal tissue becomes very difficult.

ANGIOMATA AND KELOIDS may be found in almost any situation and they should be treated by the methods previously described.

WIDE OR DEPRESSED POST-OPERATIVE SCARS, AND PUCKERED DEEPLY ADHERENT SCARS, due to old suppurative processes are often found. In certain instances the scar may be excised and the edges approximated, but recurrence often follows unless the continuity of the line of traction is broken by an S or Z-shaped incision, or by some sort of plastic flap.

X-RAY OR RADIUM BURNS, OR SCARS FOLLOWING THESE BURNS are also found, and great difficulty may be experienced in the treatment on account of the importance of the underlying structures (in certain situations) and in the depth of the tissue changes.

From the onset it should be understood that the correction of contractures is very difficult and that the process is often long drawn out. Many operations may be necessary, and careful preparation of the patient and of the prospective flaps is essential.

In all of these cases much can be accomplished before operation by systematic massage which should be instituted to loosen the skin and scar and improve the circulation.

METHODS OF TREATMENT.—After the contracture has been relieved, skin grafts are frequently used to cover the raw surface. Sliding flaps, without twisting the pedicle, are of great use in certain cases (French method); pedunculated flaps from neighboring skin with more or less twisting of the pedicle, are frequently used (Indian method); flaps from distant parts are also of great use (Italian method).

SURGERY OF THE NECK

Plastic surgery of the neck has to do almost entirely with the correction of deformities due to scar tissue following burns, operative ulceration or trauma. The great majority of cases are due to cicatricial

contracture following burns (thermic, chemical, x-ray or radium). Contractures of the neck are often associated with extensive scarring of the face, cicatricial ectropion of the lips and involvement of the upper portion of the thorax and shoulders. The extent of the involvement of the neck may vary considerably. The chin may be drawn down on the chest, and the head, neck and chest be fused into one solid mass, or there may be all gradations of contracture between thin and narrow bands of scar which prevent normal motion.

The relief of the neck contracture will, in many instances, greatly improve the appearance of the face by relaxing tension on the mouth, nose and eyelids.

The scar tissue may be very thick and dense. I have often seen it 5 cm. (2 inches) thick in places, and in these cases complete removal of this portion is essential. If any of the scar is thin and movable, it may be advisable to utilize it, at least temporarily, and to remove it later if necessary.

In cases of long standing it may be essential to divide the sternal and clavicular origins of the sterno-mastoid muscle on one or both sides, when contracture of the muscle has taken place, and the head cannot be released after thorough division of the scar tissue.

Treatment

Numerous methods have been advanced for the treatment of contracture of the neck, the object of all of them being to release the chin and to fill the defect thus made with pliable skin which is as nearly normal as possible.

Gradual Stretching.—In certain cases much can be accomplished by slow gradual stretching with some sort of apparatus, preferably elastic traction, in conjunction with x-ray, radium, massage, incisions, and other methods, but when deep thick scar is present these methods are useless, and we must resort to more radical procedures.

Division of Scar Tissue (Dupuytren, Earle, James, and others).—The earliest operative method of treatment was the division (either multiple or single) of the contracting bands down to normal tissue, and long continued over-correction of the head. If bands subsequently formed, they were divided as often as necessary, but this method was tedious and the results were generally unsatisfactory.

• **Pedunculated flaps** of the scar tissue have been shifted in various ways to relieve the contracture, and the head placed in an over-corrected

position. But almost invariably sloughing of the flap occurs and retraction frequently follows. Unless the scar is thin and very movable, it is useless to attempt to utilize it. On several occasions I have been able to shift successfully a scar of this type in the form of a wide double-pedicated bridge flap, but when normal tissue is available or should never employ flaps of scar tissue.

Excision (partial or complete) of the contracting scar is the rational method, the defect being covered with skin grafts or with

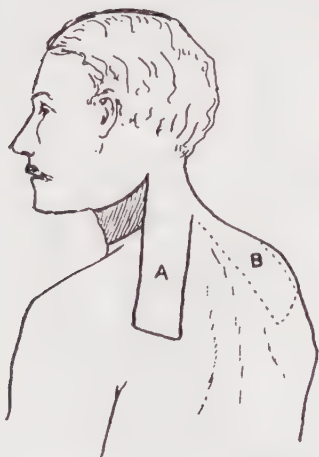


FIG. 707.

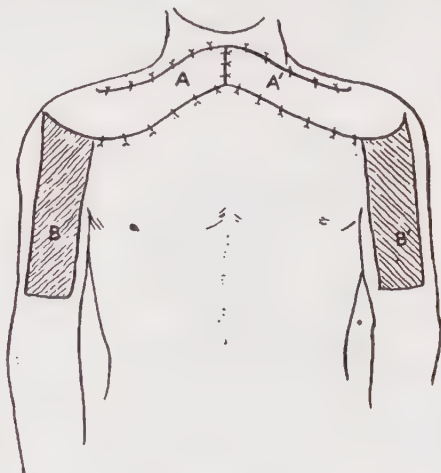


FIG. 708.

FIG. 707.—Method of utilizing a flap from the back for the relief of a neck defect (*Fig. 707*).—The dark lines outline the flap A with its pedicle on the neck at the margin of defect. This flap can only be used to cover one-half of the neck, or possibly a little more. The dotted lines mark out the flap B, which is brought forward on the other side to complete the collar of normal skin, if the defect covers both sides. The raw surface on the back should be grafted.

FIG. 708.—The use of flaps from the arms for the relief of contracture of the neck. The free ends of the flaps A and A' raised from the front of the arms and shoulders sutured in the midline, after dividing the contracting scar. The raw surfaces B and B' should be skin grafted. Croft's plan may also be used in this type of flap.

pedunculated flap. Flaps may be taken from the shoulder, the arm, the chest and the back, and should consist of the skin and subcutaneous fat.

Partial Gradual Excision.—I have often excised portions of the edge of a thickened scar on the neck and shifted up the adjacent normal skin to fill the gap, this process being continued after the skin has been stretched, until finally the entire scar was removed. This may also be done by partial excision in any selected portion of the scar tissue, and the edges may be closed after undercutting. This process

continued until the greater part of the scar is removed, and then if the necessity still exists, the desired plastic operation may be performed.

The Use of Skin Grafts.—In very extensive contractures complete excision of the thickened keloid-like scar may not be practicable at one operation. In these cases the scar may be removed at the margin, or from the central portion. The head should then be over-corrected as far as possible, and the gap filled with skin grafts (Ollier-Thiersch, or preferably of whole-thickness) if a pedunculated flap is not available.

In using grafts on the neck those of whole-thickness are the best, on account of their subsequent flexibility and ability to stretch.

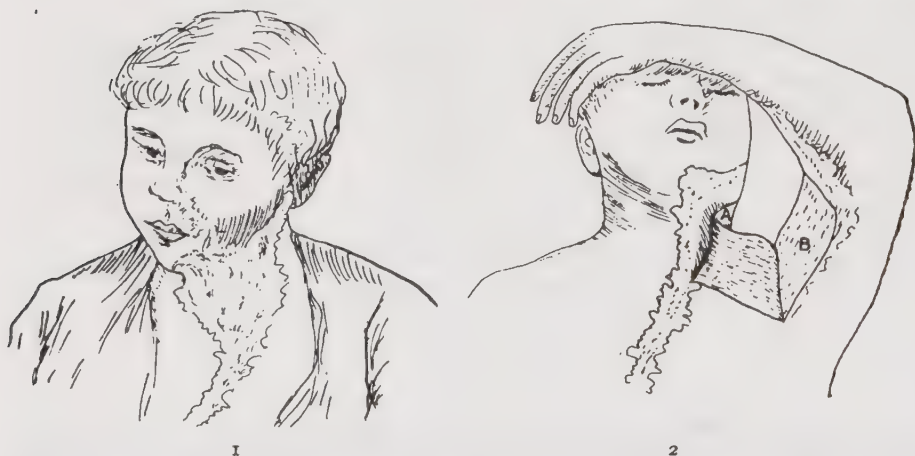


FIG. 709.—Method of utilizing a flap from the arm for the relief of a neck contracture (*v. Hacker*).—1. Contracture of the neck following a burn. 2. Pedunculated flap from the arm with its base near the shoulder. The contracture has been relieved, and the flap is turned back and its free end A has been sutured into the posterior edge of the defect. The upper and lower edges of this portion are also sutured. Later the pedicle is cut and the ends are fitted in. The defect B on the arm should be grafted.

Ollier-Thiersch grafts are often used, but are not so satisfactory as whole-thickness grafts for this purpose. Small deep grafts should be used only as a temporary measure to hasten cicatrization, although the healed surface is later to be removed.

The Use of Pedunculated Flaps.—Divide the scar transversely through its center from normal skin to normal skin, and over-correct the head. Trim off as much of the scar from the edges as may be desired, and implant a flap which is a little wider and longer than the defect. If the defect is on one side only, or in the middle, one flap may be sufficient, but if it extends well around the neck, a flap must be obtained from each side.

If the neck only is implicated and the shoulders and thorax are free, the problem is more or less simple, because flaps may be obtained from these regions. But in many cases it is a difficult matter to obtain flaps from adjacent skin on account of scar involvement, and we have to obtain them from distant parts by double or single transfer.

When a long flap is used, it is safer to raise it from its bed, but leave it attached at its extremities, and gradually divide the free end from its attachment. In this way we may succeed with a flap which if raised and at once shifted, would slough for at least one-third of its length.

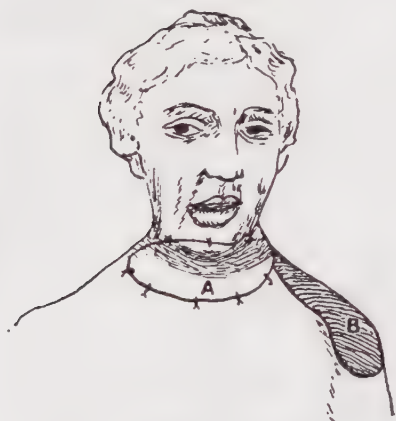


FIG. 710.

FIG. 710.—The relief of a contracture of the neck with a flap from the shoulder and deltoid region (*Mütter*).—The flap A is shown in position after the neck contracture has been relieved. The area B, from which the flap was raised, should be grafted.



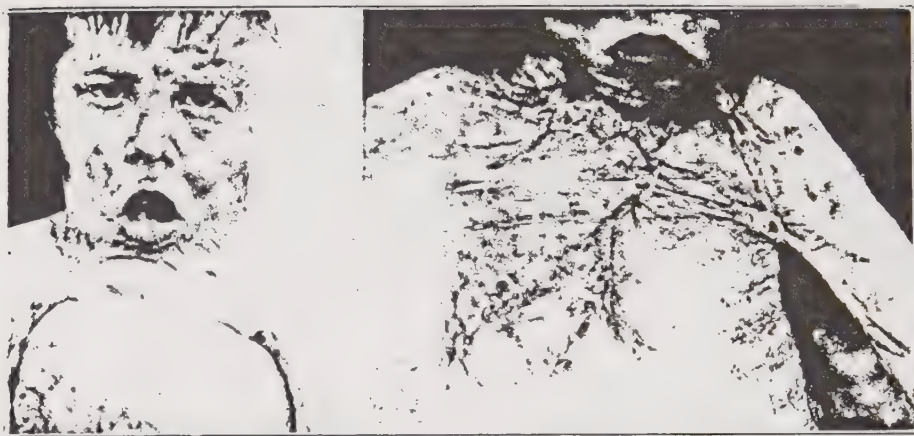
FIG. 711.

FIG. 711.—The relief of a contracture of the neck with a flap from the chest wall (*Morestin*).—The contracture has been relieved and the large flap shifted up from the chest wall to fill the defect.

Tracheal Defects

Occasionally the plastic surgeon is called upon to repair a tracheal fistula, or even to reconstruct a portion of the trachea which may have been destroyed by trauma, operation, ulceration, or a burn.

In a recent paper on the experimental transplantation of the trachea, Burket found that the normal trachea was sterile from the larynx to the hilus of the lung. He was able completely to remove and replace in the same dog successfully as many as eight tracheal rings, but his is-



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FIG. 712.—Contracture of the chin, neck and chest following a burn.—1. The condition of the patient when he came under my care. He had been operated on several times before, and nearly all of the available usable material had been exhausted. Note the scar on the face, neck, chest, shoulders and arms. 2. Taken eighteen months after the first photograph. Note the improvement in the condition of the cheek and chin, and the partial release of the arms.



1

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FIG. 713.—Contracture of the chin, neck and chest *continued*.—1 and 2. The condition three years later, after several other plastic operations. The chin is released and with minor procedures can be much improved. The arms can be raised over the head and are functionally perfect. Note the newly formed axillae and compare with 2, Fig. 712. Cases of this type are difficult to deal with and good results are dependent on the perfect coöperation of the patient and the parents with the surgeon.

transplants were not so successful. This work may be of great clinical use in certain cases, and is well worth bearing in mind.

Treatment.—It is usually necessary to perform a tracheotomy (preferably transverse) below the defect before closing any gap in the trachea. This precaution may save much worry and discomfort.

Occasionally, when the defect is very small, the edges may be freshened and sutured together (Dupuytren, Le Fort, Jacobson). In other cases the tissue on each side of the defect may be raised and turned inward and sutured, so that the epithelial surface is toward the lumen

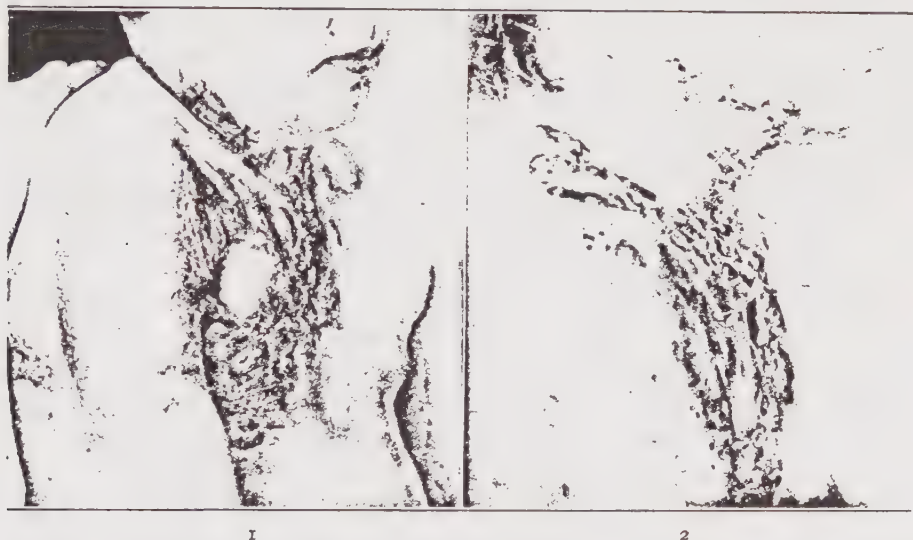


FIG. 714.—Contracture of the neck following a burn.—1. Note the practical elimination of the neck on right side. Also the scars on the neck, chest, arm and back. 2. The relief of the contracture by the use of a pedunculated flap from the shoulder and back. Taken two weeks after operation.

of the tube (Berger). The raw area is then covered by sliding in adjacent skin, or by any other selected method.

Complete excision (Küster, 1885) of the defective portion of the trachea (from 2. to 4. cm. = $4\frac{1}{2}$ to $1\frac{3}{4}$ inches) and successful suture of the ends has been done, but on account of the dangers of infection and inability to extend the neck because of the shortening, this procedure is not always advisable. The amount which can be resected depends largely on the length of the neck, and the distance between the rings.

Silver wire mesh (Landerer, Grosse) has been shaped and placed over the defect, and the soft parts closed over it; rubber tubes and other inorganic substances have been used, but these buried prostheses are to be advised no more in this region than elsewhere.

Pedunculated flaps of skin have been shifted over the defect (Reid and others), but unless the gap is small, the lumen of the trachea may be blocked. It is better to turn in a flap with epithelium toward the lumen to fill the gap and later to cover this with another flap (Abbe and others). To avoid sagging of the skin, flaps containing a supporting substance are to be preferred. Pedunculated flaps containing undetached bone from the sternum (Schimmelbusch) or clavicle (Photiades, Lardy) have been used. Chiari uses Gluck's technic. He shifts in a quadrangular flap from one side of the neck to form the posterior wall of the trachea. After this has healed a flap from the other side is sutured, skin surface inward, to form the anterior wall, and over this is placed a flap containing a thin layer of bone from the sternum. König used a pedunculated flap of skin, with cartilage attached, from the thyroid cartilage.

Free bone has also been implanted beneath the skin and has later been shifted with the skin flap to fill the gap, but this material will eventually be absorbed and is therefore not reliable.

None of these methods can compare with the use of cartilaginous rib (von Mangoldt, Oct. 5, 1897) implanted beneath the skin, to be shifted later. I have found it advantageous, when implanting cartilage into the skin of the neck to reform the trachea (if the gap is of any length) to make narrow notches transversely about 1 cm. ($\frac{3}{8}$ inch) apart, down to but not through, the perichondrium. This will allow a certain amount of flexibility to the newly formed trachea. In a long wide defect a central longitudinal notch may also be made in a wide piece of cartilage, to allow for slight lateral bending to form the wall of the trachea. I have found it a good procedure in large defects to implant cartilage parallel to the defect, and fairly close to it on each side. Then, after a number of months, I raise a rectangular lateral flap on each side with the pedicle close to the margin of the defect, and turn over these flaps, including the cartilage, skin side inward, and suture them in the midline. The raw surface of the prepared flaps and the defects from which they have been raised, are covered with a pedunculated flap of skin. If the defect is large, it is better to wait until the new tube is completed before connecting it with the trachea above and below. If the thyroid cartilage is destroyed, an effort should be made to shape the cartilaginous rib which is to be used in repairing it, before it is implanted. My experience has been that it is difficult to maintain the cartilage in the V-shape, but this form may be again regained if the cartilage ends can be secured (at the time of final transplantation)

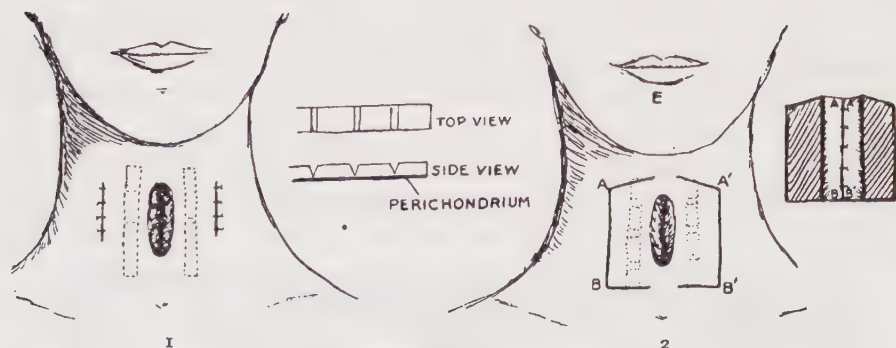


FIG. 715.—Method of reconstructing a gap in the trachea.—1. The dark lines indicate the incisions through which the pieces of cartilaginous rib were implanted parallel to the defect. The dotted lines indicate the location of the notched cartilage. The perichondrium is outward. The inserts show the method of notching the cartilage in order to give it more flexibility. More than one piece of cartilage may be implanted on each side if necessary. 2. The dark lines indicate the flaps with their bases toward the midline. The insert shows the flap turned in and sutured, the edge AB to the edge A'B'. The raw surface may be grafted, but a pedunculated flap is preferable.

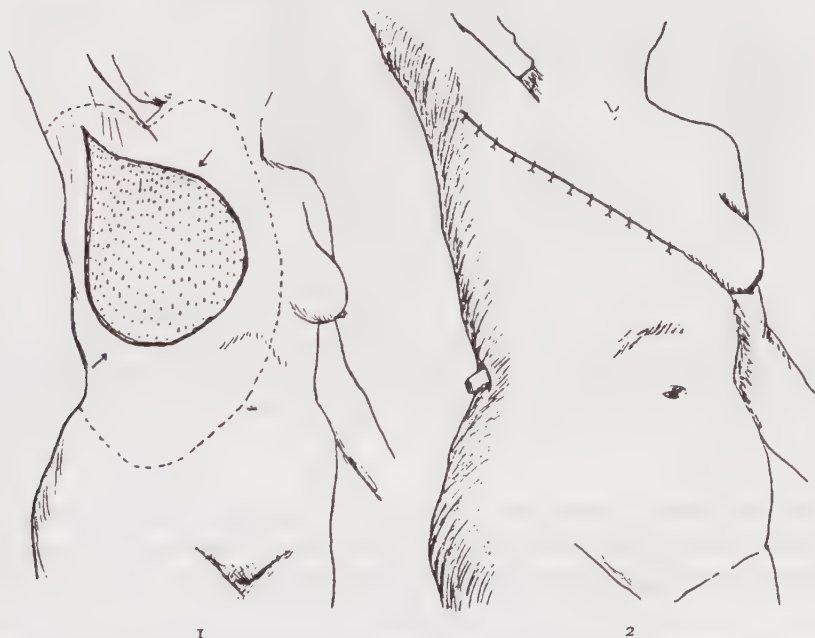


FIG. 716.—Method of closing a large chest defect by extensive undercutting and shifting the surrounding skin (*Morestin*).—1. The shaded area indicates the defect. The dotted line shows the extent of the undercutting necessary in order to close the skin over the defect. 2. The edges sutured and the wound covered.

to the remains of the thyroid cartilage. In the repair of large gaps in the trachea the operations are multiple, and the results are only fair. In small gaps involving only a portion of the tracheal rings, results are much better (Fig. 715).

In tracheal fistulæ in which not more than one-third of the circumference of one or two of the cartilage rings has been destroyed, I have been able, experimentally, to close the defect with a graft of fascia lata

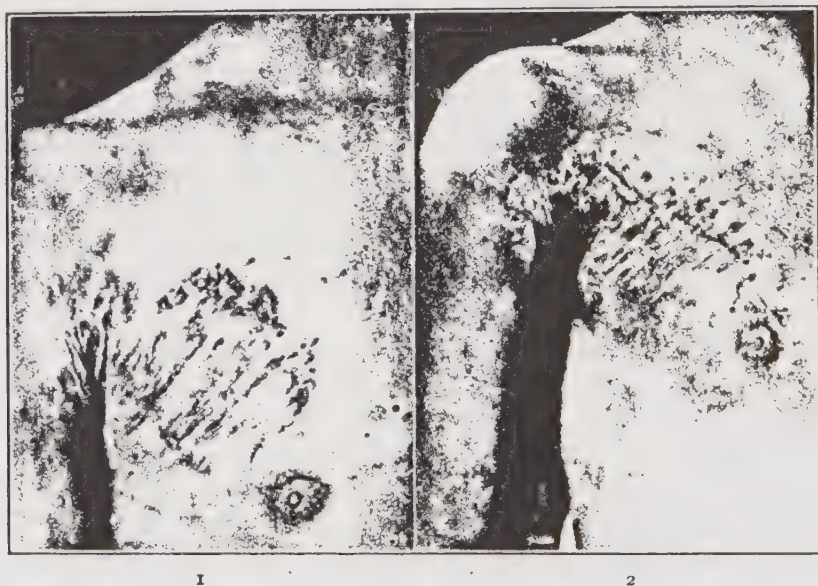


FIG. 717.—Pigmented mole of the chest wall. Congenital. This patient before coming under my care had been treated with carbon dioxide snow, and an attempt had been made to lower the growth into the axilla where it would not show. The only method of treatment which promised a satisfactory result was partial gradual excision.—1. The result of the first operation, in which the greater part of the pigmented area was removed, and the edges were closed. 2. Result of the second excision. Further excisions will be necessary, but in time the entire area will be removed without distortion of the part, and with the scar at the pectoral margin.

which is snugly sutured over it.¹ Later the microscopic sections showed that the mucous membrane covered this graft and was continuous with the lining of the rest of the trachea. The method is simple, and unless the gap is too wide is well worth trying.

SURGERY OF THE TRUNK

Plastic surgery of the trunk for the most part deals with the relief of contractures, and the covering of the defects (due to operation, injury or ulceration) with skin.

¹Davis, J. S., "Johns Hopkins Hospital Bull.," October, 1911, 372.

With the exception of a few words on the treatment of hernia of the lung through the thoracic wall, the surgery of the trunk will be dealt with here only so far as it concerns the repair of surface defects and contractures.

Usually extensive contractions of the neck and axilla are closely associated with those of the trunk. Many small defects may be closed by the plastic methods previously described. I have seen extensive contracted scars involving the entire front or side of the chest and

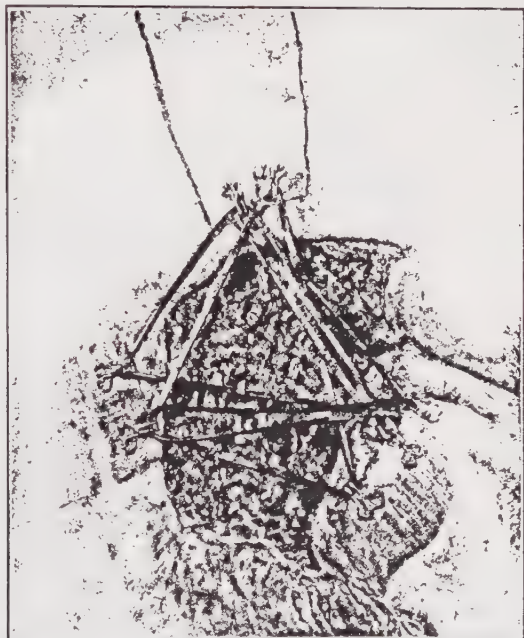


FIG. 718.—Method of reducing the size of a granulating wound by elastic traction.—The wound pictured was due to the excision of the breast for a severe infection. Note the muslin bands, to which the hooks are sewed, pasted to the skin. Ordinary small elastic bands are placed over these hooks and they exert continuous elastic traction on the skin edges. In this way the size of the wound may be considerably reduced in a comparatively short time.

abdomen, and the upper portion of the thigh. To avoid permanent asymmetry it is essential to break the continuity of such scars in several places in order to straighten the body (complete excision being out of the question). This should be done as early as possible and can be accomplished by means of skin grafts alone (preferably of whole-thickness), or with pedunculated flaps shifted in from any available normal skin. Sometimes a combination of these methods is advantageous. The skin of the trunk is a very useful source of supply in obtain-

ing pedunculated flaps for use on the neck or upper extremity. By a double transfer these flaps may be carried to the face, or to any other desired situation.

Morestin has demonstrated that very large areas of skin may be shifted by undercutting, and he undermines extensive areas, as much as 25. to 30. cm. (10 to 12 inches) when necessary, in order to free the skin sufficiently. I have frequently used this method and find it a most useful procedure.



FIG. 719.—X-ray burn of the chest. Duration four years.—The breast had been amputated for carcinoma eight years before admission, and after amputation X-ray treatments were given very frequently for the succeeding four years. A burn resulted which involves the chest, shoulder, upper arm and axilla. During the four years preceding admission no further X-ray treatment was given. The area which can be seen in the photograph is a typical X-ray burn which heals and breaks down. The skin and tissues are hard and adherent. Telangiectatic patches are everywhere and the entire area is exquisitely tender. The area was completely excised and the wound was grafted with small deep grafts, after the granulations were in proper condition.

The Closure of Defects After Operation for Carcinoma of the Breast.—The feeling of all of us who have been connected with Dr. Halsted's Clinic at the Johns Hopkins Hospital is that none of the plastic closures so elaborately described in certain articles on carcinoma of the breast are necessary, and in fact are often undesirable after the radical breast amputation. The best results in breast amputations for malignant disease have undoubtedly been obtained by the operators who remove the tumor with a very wide margin of skin.

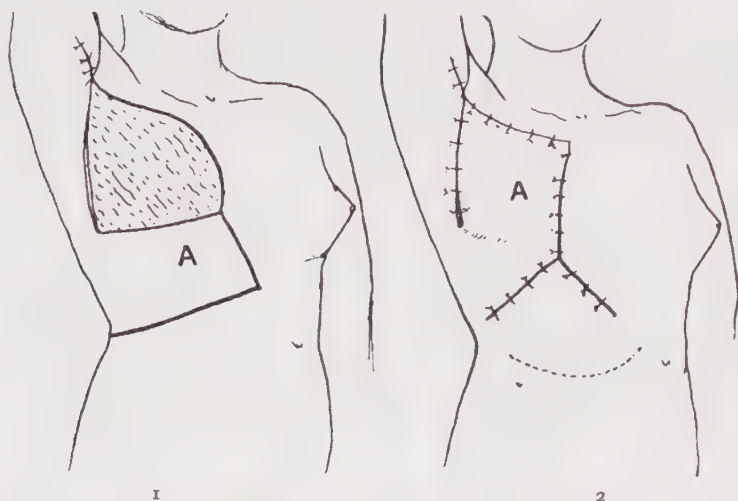


FIG. 720.—Operation for closing a chest defect (*Quénu and Robineau*).—1. The defect is indicated by the shaded area. The flap, by the dark lines. 2. The flap A shifted upwards and sutured into the defect. The curved dotted line indicates the extent of the undermining required.

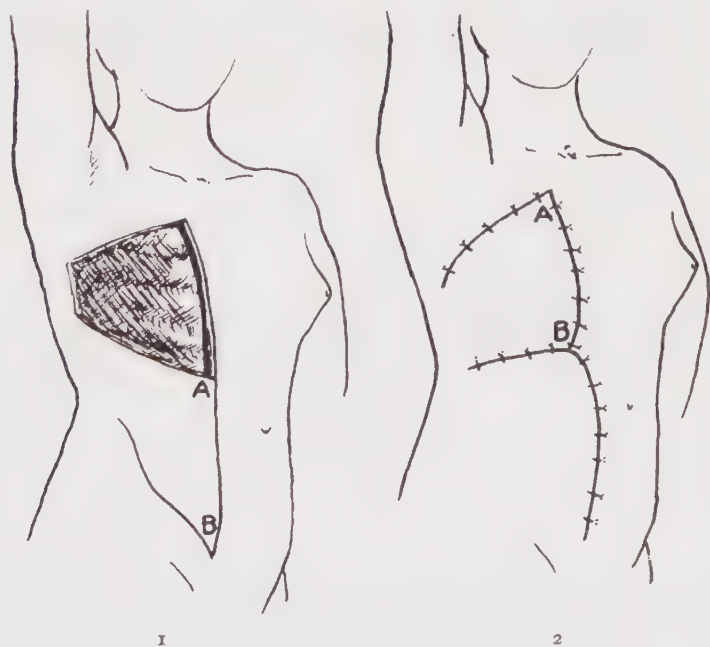


FIG. 721.—Method of closing a chest defect with a flap from the abdominal wall (*Elsberg*).—1. The shaded area indicates the defect. The dark lines indicate the outline of the flap of skin and fat raised from the abdominal wall. 2. The flap shifted upwards and sutured.

If the surgeon has in mind immediate closure of the edges he is apt to skimp on the amount of skin which he removes. It is unquestionably better to remove too much skin than too little in these cases, because

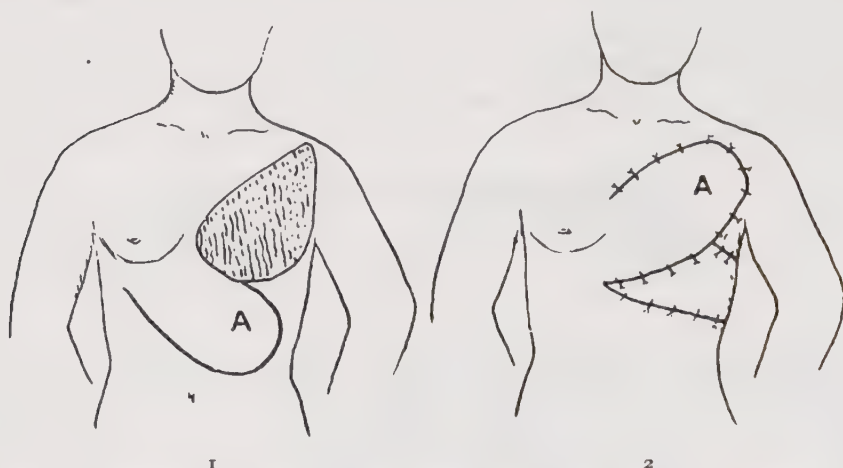


FIG. 722.—Method of closing a chest defect with a flap from the abdominal wall (Weichert).—1. Shaded area indicates the defect. The dark line below marks out the flap. 2. The flap A raised and sutured into position. The other skin defects are also sutured.

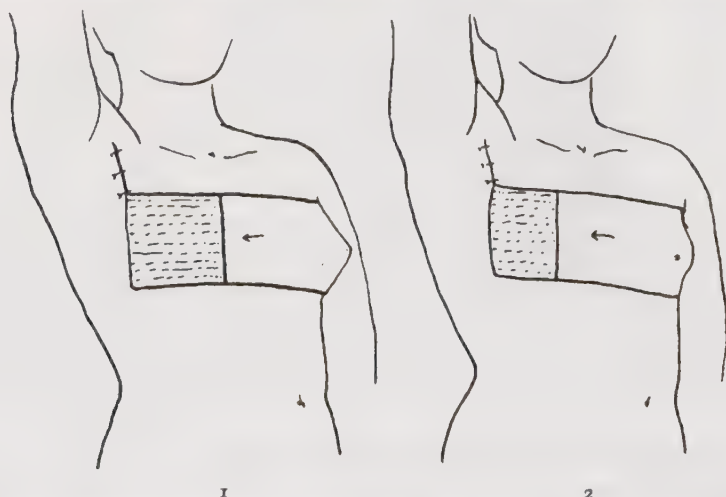


FIG. 723.—Operation for closing a chest defect, by utilizing the other breast (Leguen).—1. The dotted area indicates the defect. The dark lines indicate incisions outlining the flap. 2. The flap shifted toward the defect and sutured.

the defect however large, can be immediately grafted with Ollier-Thiersch grafts, which are those usually selected.

I shall describe here Dr. Halsted's latest method of forming an axilla after breast amputation, as it may be useful in dealing with other

defects. It is applicable, however, only where the surrounding skin is normal. For removing the breast Dr. Halsted uses a circular incision surrounding the tumor, and extending from this a vertical incision toward the clavicle, if necessary, and another one below which aids in the dissection of the axilla. To quote his words: "The skin of the outer flap between the two vertical incisions is utilized primarily to cover completely, without any tension whatever and redundantly, the vessels of the axilla. The edge of this flap is stitched by interrupted buried sutures of very fine silk to the fascia just below the first rib in such a way that the skin partly envelopes the large vessels. Then, along the entire circumference of the wound, the free

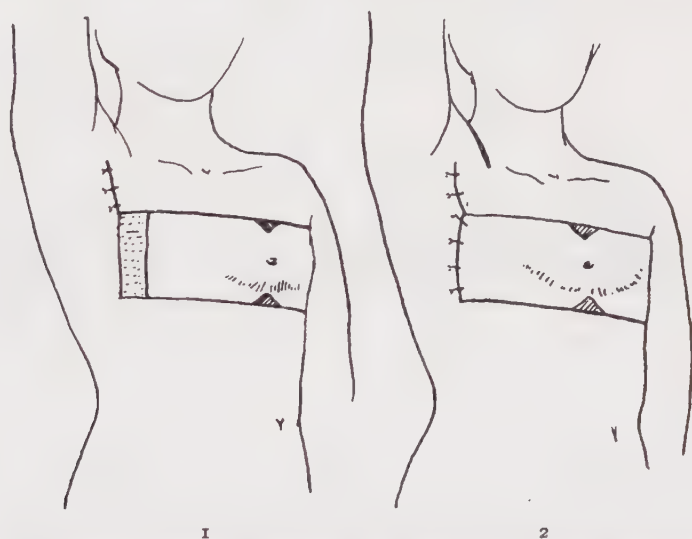


FIG. 724.—Legueu's operation, *continued*.—1. After stretching has taken place the flap is shifted still further. Note the notches made above and below to facilitate stretching. 2. The flap in position. This draws the normal breast to the midline.

edge of the skin is sutured to the underlying structures of the chest wall, the wound being made as small as desirable in the process of closure, and tension of the upper or axillary part of the outer flap assiduously avoided. Considerable traction may, however, be exercised on the mesial flap and on the lower portion of the outer flap. Whatever the size and shape of the grafted defect, it should usually extend to the top of the axillary fornix. Thus the thoracic or inner wall of the apex of the axilla is always lined with skin grafts."

Skin grafts seem to offer a definite obstacle to the growth of metastases, and it is very rare, if ever, that the grafted area is invaded

If metastases occur in the deeper tissues beneath the graft, they can be seen and attended to.

The operation of shifting the other breast over to cover the defect following breast amputation is not only unnecessarily extensive, but also prevents the early recognition of any metastases, because of its thickness.

Methods of Closing Defects on the Trunk.—Many methods have been devised for closing the defect after amputation of the breast, and the principles involved in the majority of these may be applied in filling defects anywhere on the trunk. My belief is that plastic opera-

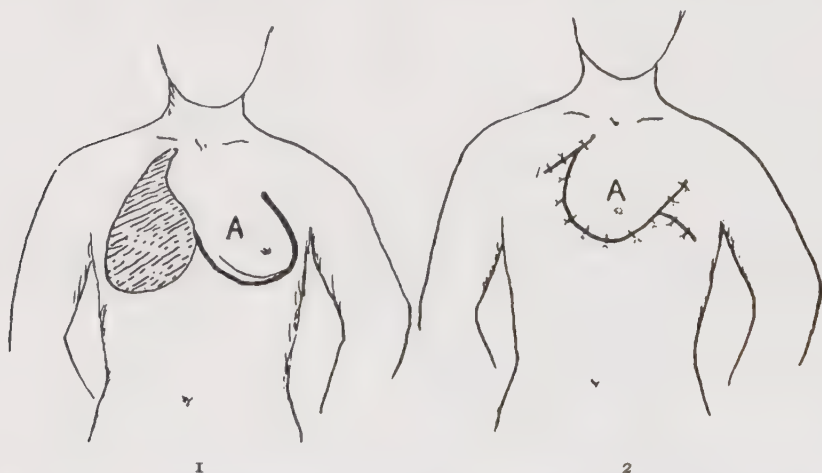


FIG. 725.—Method of closing a chest defect by means of a flap including the other breast (Weichert).—1. The defect is indicated by the shaded area. The dark line indicates the incision marking out the flap A. 2. The flap A in position and all wounds closed.

tions are not desirable in covering defects left by the radical operation for carcinoma of the breast, such as shifting over the other breast, but that they may be used with great advantage in covering defects from other causes. Unfortunately, all of these flap operations on the trunk are based on the utilization of skin which is not infiltrated with scar, and a glance at the diagrams will show the impossibility of carrying out successfully these methods unless the skin is normal. For this reason in many instances we must depend on skin grafts. In large defects the Ollier-Thiersch variety is that usually employed on the trunk, but when the defect is smaller, whole-thickness grafts give good results. I often use small deep grafts on granulating surfaces on the trunk, and find them very satisfactory.

The French method of gliding flaps is that most frequently em-

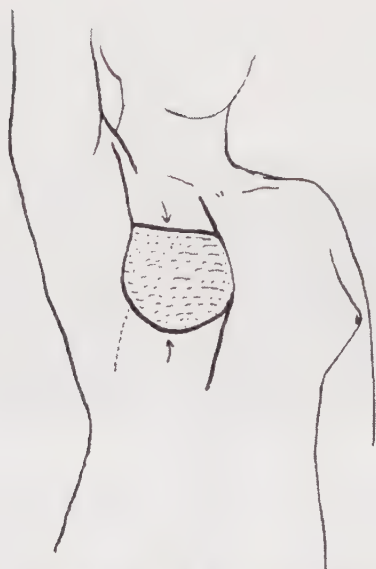


FIG. 726.—Operation for closing a chest defect (*Roux, Beck*).—The shaded area indicates the defect. The three dark lines show the incisions made in Roux's operation. The dotted line indicates the additional incision made in Beck's operation. The flaps are shifted toward each other and are sutured.

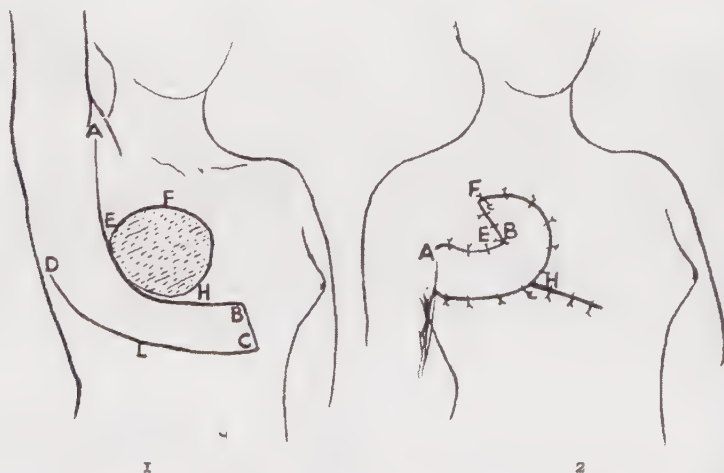


FIG. 727.—Operation for closing a breast defect (*Ombriédanne*).—1. The dotted area indicates the defect. The dark lines the incisions outlining the flap. The flap ABCD is raised and half turned on itself, the point B being brought to the point E. 2. The flap sutured into position and all skin defects sutured.



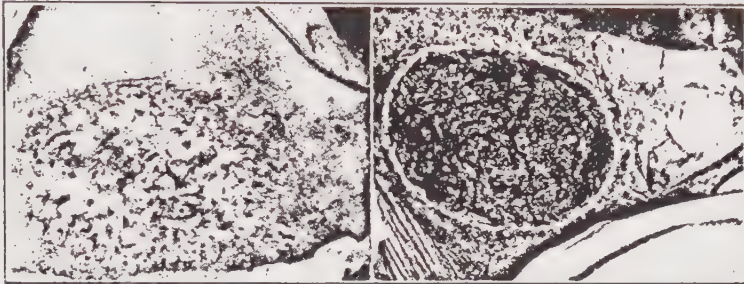
FIG. 728.—Operation for closing a large chest defect (*Shrady*).—1. The shaded area indicates the defect. The dotted lines indicate the incisions made in forming the flaps. The flaps shifted and the edges sutured.



FIG. 729.—Modified Tansini's method of closing a chest defect.—1. The shaded area indicates the defect. The dark lines mark the outline of the flap A. 2. The flap A is sutured over the bridge of skin between and sutured into the defect. The area from which the flap is raised is either sutured or grafted. For our purpose only skin and subcutaneous tissue is included in the flap. In the original operation the flap contained the latissimus muscle, the teres major and a portion of the infraspinatus muscles.

ployed, but flaps from neighboring skin with twisting of the pedicles are also very useful. A pedunculated flap from the arm may be utilized to fill a trunk defect, but this is not often a desirable procedure.

In shifting flaps to fill defects we have to choose from several varieties. A single flap from below and on the same side (Quénu and

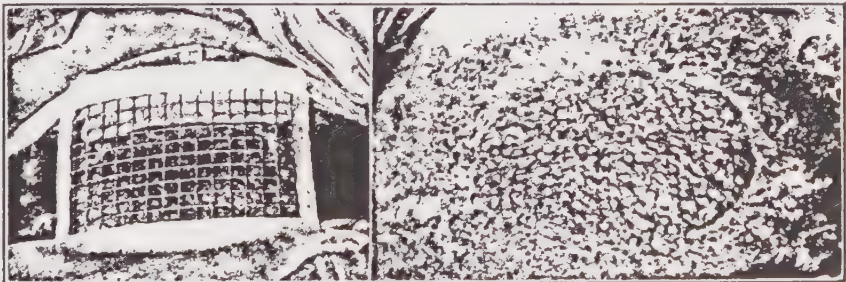


1

2

FIG. 730.—X-ray burn of the abdominal wall. Duration fifteen years.—1. Note the extent of the burn and its typical appearance. 2. The area after excision of the burn and after granulations have formed.

Robineau, Elsberg and others); a single flap from below and on the opposite side (Weichert and others); a single lateral flap from the opposite side (Legueu and others); a single external dorsal flap (Tansini); double vertical flaps (Roux and Beck); four flaps, two above and two below, with lateral pedicles (Shrady).



1

2

FIG. 731.—X-ray burn of the abdominal wall, *continued*.—1. The use of a wire cage in protecting the grafted area. 2. Taken three months after grafting with small deep graft. There has been no further trouble during the two years since operation.

Adhesion Between the Arm and Thoracic Wall

This condition often follows extensive burns of the arm and chest. The web may be quite thin and lax, allowing a considerable amount of

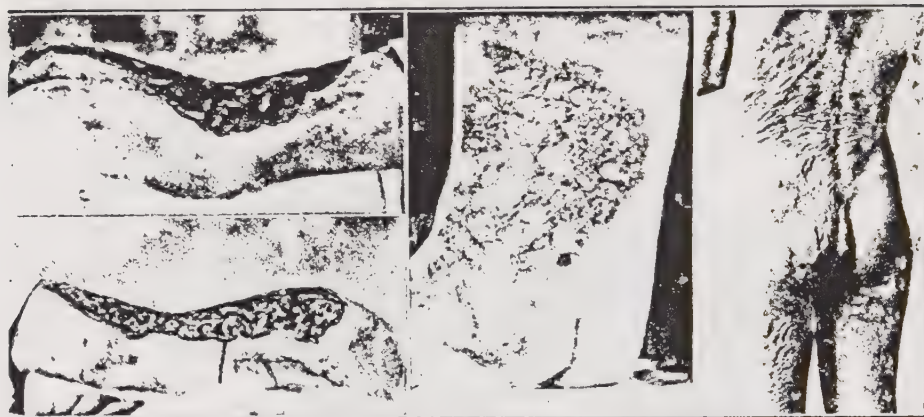


FIG. 732.—Ulcer of the buttock and side due to a burn. Duration three months.—1 and 2 show the extent of the burn. The whitish patches in 1 are grafts which were applied before the patient came under my care, and which are nearly covered with exuberant granulations. The granulations were trimmed off, the grafts previously placed were carefully preserved, and the rest of the area grafted with small deep grafts. 3. Healing soon followed. Note the larger grafts which had been buried in the granulation tissue and which spread promptly when given a chance, and the spaces between filled with small deep grafts. The photograph was taken six weeks after admission. 4. Photograph taken one year later. Note the smooth movable healing.

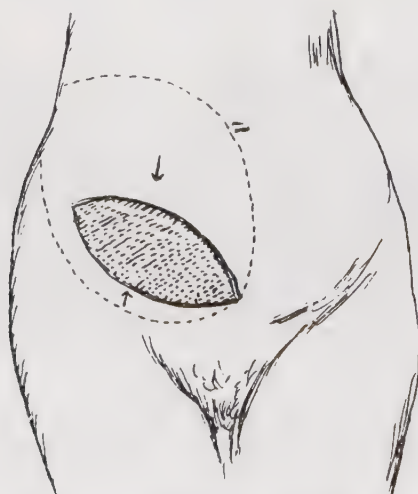


FIG. 733.—Method of closing an abdominal defect by extensive mobilization of the surrounding skin (*Morestin*).—The shaded area indicates the defect after excision of the growth. The dotted line shows the area of skin mobilized by undercutting before closure as far as possible.

motion, but in other cases it may be as thick as the arm and absolutely rigid. When the arm has been closely adherent to the chest wall for some time, care should be taken when it is released to raise it slowly, in order to stretch the vessels and nerves gradually.

Treatment

Division and Suture of Edges.—The natural tendency for the inexperienced operator is simply to divide the web, abduct the arm and suture the edges. For thin incomplete webs this may be accomplished with S or Z-shaped incisions, with some success, but recurrence will invariably follow such a procedure unless it is done with more than ordinary skill.

Formation of Epithelial Lined Fistula.—Along the same line is the relief of these contractures by first making a fistula high up toward the axilla and allowing the edges to heal, as was done in old operations for syndactylism and for the formation of oral commissures. Then, after healing has taken place to divide the web. This is a poor surgical procedure and a good axilla can never be formed by this method alone.

Reconstruction of the Axilla.—The formation of a high, well lined axilla is the key to the satisfactory relief of these conditions, and this may be done in several ways. The choice of operation depends largely on the character of the web, and on the condition of the skin on the arm and trunk immediately adjacent to the contracture. If the skin is normal, or only superficially scarred, it may be used for flaps. But when scar is wide-spread and deep, the problem is much more complicated, and flaps must be shifted in from parts at a distance, or skin grafts must be used.

After the chest wall and axilla, or the arm and axilla, are covered with grafts (preferably of the Ollier-Thiersch variety) the danger of adhesion is over, and if any secondary contracture occurs, or there is limitation of motion, after skin grafting, it is comparatively easy to correct it.

Some of the operations already mentioned for covering chest defects after complete removal of the breast, modified to suit conditions, may be utilized for the formation of the axilla after the division and excision of the web, especially those of Halsted, Tansini, and Elsberg. But all of these are based on the use of normal skin flaps and, if the skin is infiltrated with scar, they cannot be employed.

When the axilla is obliterated, and the upper portion of the arm is bound to the chest wall, numerous methods of utilizing flaps to form the axilla have been described, all of them being based on the supposition that the surrounding skin is normal, a condition seldom found in actual practice.

Jobert's Operation.—Jobert raises a transverse flap, from the chest, of sufficient length and breadth with its pedicle above the axillary fold, and turns it backward to line the axilla.

Chaput uses a vertical flap from the skin of the breast and chest with its pedicle above, and on the level with the axilla. This flap is

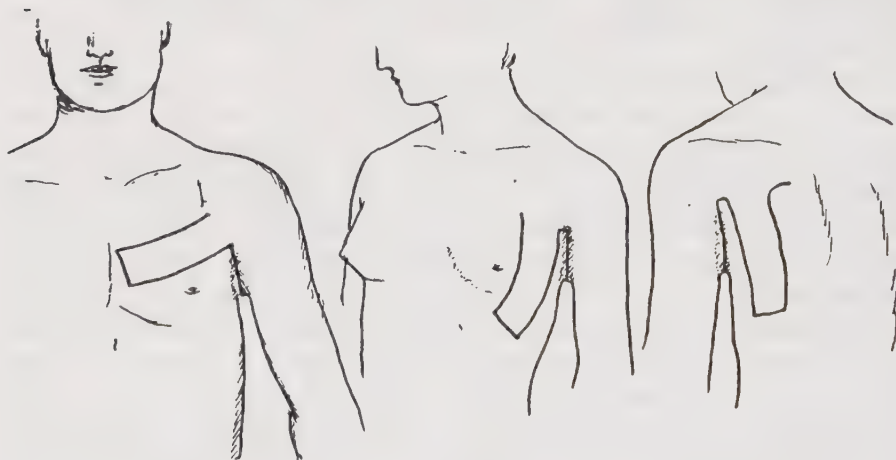


FIG. 734.

FIG. 735.

FIG. 736.

Operations for the restoration of the axilla by the use of pedunculated flaps.

FIG. 734.—Jobert's operation.—The dark line indicates the outline of the flap from the chest and also the line of division of the web.

FIG. 735.—Chaput's operation.—The flap is raised from the chest wall with its pedicle above.

FIG. 736.—Berger's operation.—The flap is raised from the scapular region with its pedicle above.

turned back to form the axilla. **Berger** raises a somewhat similar flap from the skin of the back for the same purpose (Fig. 734-736).

In more extensive cases the procedure of **Défontaine** may be useful. He makes a vertical Y-shaped incision on front and back, the arms of which begin in the normal skin just above the level of the axilla, and meet at the junction of the upper and middle thirds of the web. The V-shaped flaps of skin included between these incisions are dissected up, and the shaft of the Y is completed by dividing the web in the midline. The arm is then loosened from the trunk and raised. The flaps are then turned in to the axillary defect and sutured, the anterior being

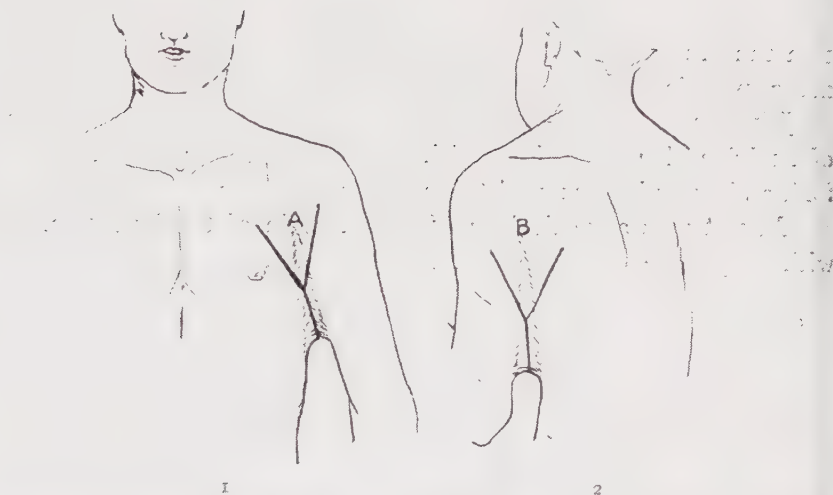


FIG. 737.—Operation for the restoration of the axilla by the use of an anterior and posterior flap (*Défontaine*).—The dark lines indicate the incisions made for outlining the flaps A and B dividing the web. After the arm is raised the flaps A and B when drawn together overlap, A being placed inside, and B outside.

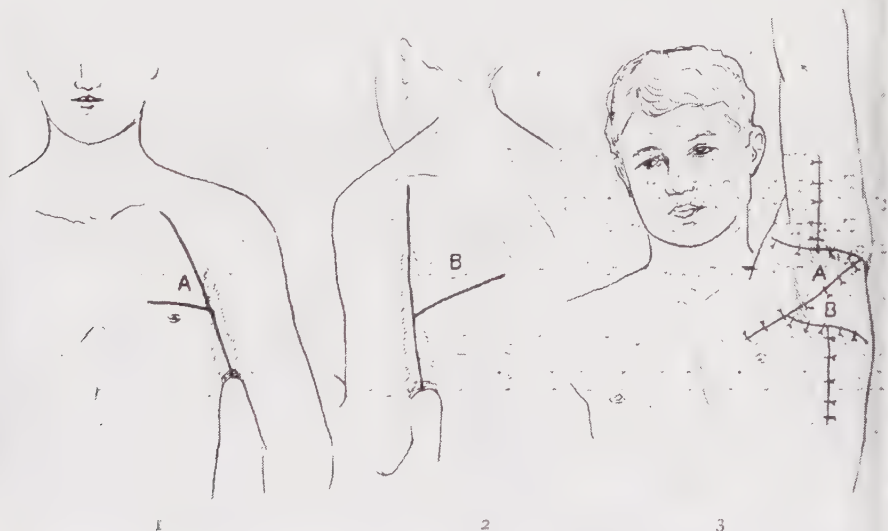


FIG. 738.—Operation for the restoration of the axilla (*Piéchaud*).—1 and 2. The dark lines indicate the incisions outlining the flaps A and B, and dividing the web. 3. Shows the flaps shifted in to form the axilla, the flap A being placed above the flap B.

inside, and the posterior outside. All other defects are then closed by undercutting. In this operation, however, the central portion and tip of each triangular flap is composed of scar tissue, and slough will usually follow. Moreover, the closure of the defects on the chest and arm are seldom possible, because of the lack of a normal skin (Fig. 737).

Piéchaud's operation is based on the same principle as that of Défontaine. He raises much wider triangular flaps from the chest wall in front and back, the bases of the triangles being inward. After

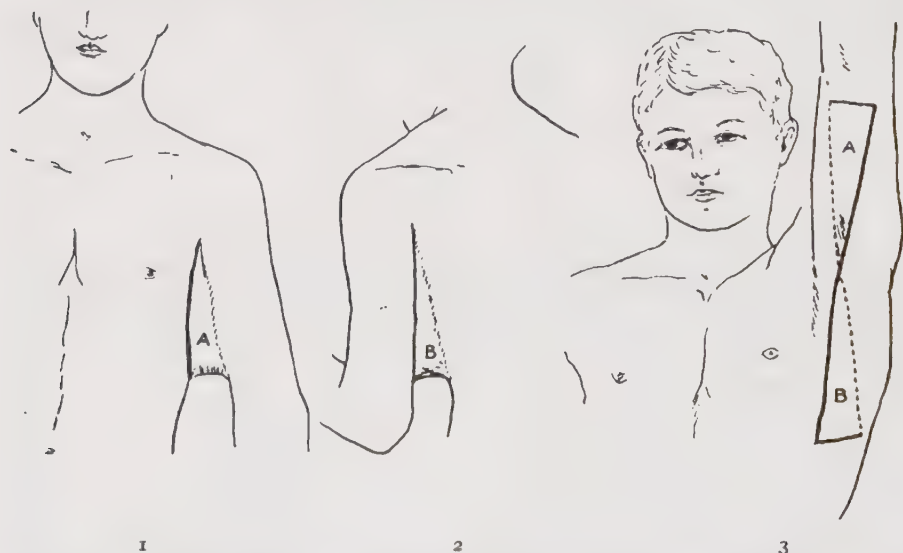


FIG. 739.—Operation for the restoration of the axilla (Berger).—1. The dark lines indicate the incisions made to form the flaps A and B. The anterior incision being at the junction of the skin of the chest with the web, and the posterior at the junction of the skin of the arm with the web. These incisions are joined by a transverse cut across the bottom of the web. 2. Shows the scar tissue flaps in position. The flap A filling the arm defect, and B filling the chest defect.

Dividing the contracture and dissecting up the flaps, he turns them in to form the axilla, the anterior flap lying in front of the posterior flap. All other wounds are also sutured so that the gaps are entirely closed. This procedure is much better than that of Défontaine, inasmuch as the flaps are larger, the blood supply is better, and there is little scar tissue included. This operation depends for its success on the presence of adjacent normal skin (Fig. 738).

Berger's operation for extensive contracture, although in my experience without merit, will be described for the sake of completeness. He makes an incision in front along the full length of the thoracic margin of the contracture, and a similar incision behind along the

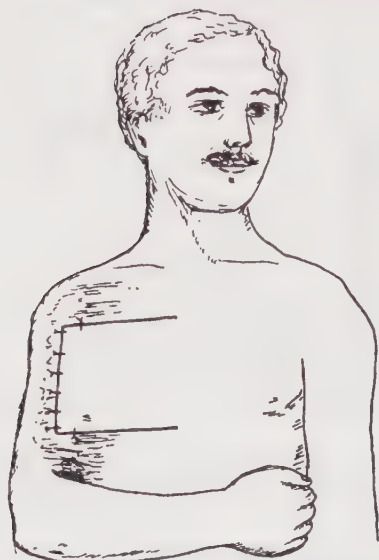


FIG. 740.—The use of a sliding flap from the chest to relieve dense adhesions between the arm and chest wall.—When the adjacent skin of the chest is not involved, with scar tissue for any considerable distance from the web binding the arm to the thorax, a large lateral flap may be raised and shifted into a raw surface prepared for it on the arm. After healing has taken place the pedicle is divided, preferably a little at a time. When the division is complete the web is divided and the free end of the flap is turned around the arm and sutured. The chest defect is grafted.

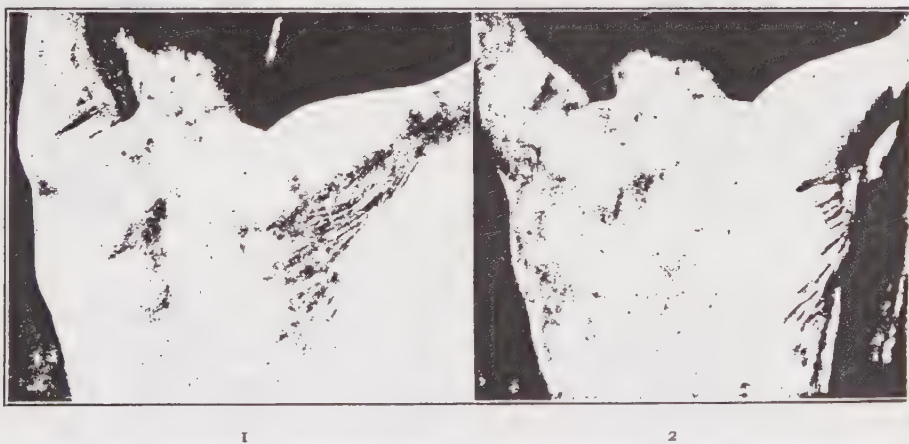


FIG. 741.—Obliteration of the axilla by a partial thick web of scar tissue, following a burn.—1. Note the limit of abduction. The axilla was formed by shifting flaps from the chest and back. 2. Photograph taken three weeks after operation. During the last three years the function of the arm has become practically normal.

arm margin of the contracture. A transverse cut along the lower border of the web unites the lower extremities of these incisions. In front a flap is dissected up with its base on the arm. Behind, a flap



FIG. 742.—Obliteration of the axilla and contracture of the cubital space following a burn. Duration three years.—1, 2 and 3. The wide extent of the scar which can be seen eliminates the use of the greater portion of the adjacent tissue in forming the new axilla.

is dissected up with its base on the chest. The arm is then separated from the body and raised. The posterior flap is sutured to the skin of the chest, and the anterior flap is sutured to fill the arm defect. Both



FIG. 743.—Obliteration of the axilla and contracture of the cubital space, *continued*.—1 and 2. A sharply curved flap with its pedicle above was raised and straightened and after division of the web was turned in to form the apex of the axilla. Its free end reached to the posterior axillary line where it was sutured. The defect from which it was raised was grafted, as were the other uncovered areas. The photographs were taken one year after the operation and show considerable improvement in the condition. 3. Taken two years later. Note the ability to raise the arm. Function is now quite perfect.

of these flaps are composed almost entirely of scar tissue and their usefulness is problematical (Fig. 739).

In my own experience I have found in the large majority of cases that the skin of the arm and chest, and adjacent portion of the abdo-

men, is often entirely infiltrated or replaced by scar, and few if any of the operations described can be carried out as desired. I have been forced on several occasions to form the axilla by means of a long curved flap taken from the top of the shoulder and clavicular region, or from the scapular region, and to cover the rest of the defect with skin grafts.

Preservation of the Contour of the Breast.—In those cases of chronic fibro-cystic-mastitis which require only removal of breast tissue, Willard Bartlett has devised an ingenious operation in which the contour of the breast is preserved, and he reports good results. He makes a crescentic skin incision in the fold under the breast, lifts the breast off the chest wall, dividing all attachments with the cautery, and packs this cavity with gauze. He then strips back the skin over the gland with the cautery, being very careful to avoid injury to the skin, and

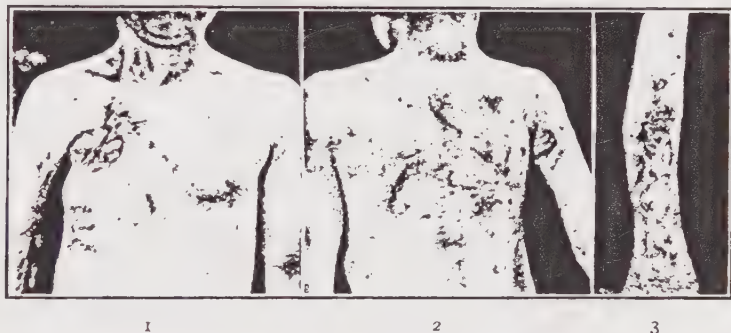


FIG. 744.—Obliteration of the axilla with contracture of the cubital space, *continued*.—1 and 2. Note the height of the axilla in front and behind. 3. Shows the arm and forearm extended following a plastic operation with grafting. The use of a pedunculated flap from the chest or abdomen was not possible for the cubital space, on account of such extensive scar involvement. The lesson taught in this case is the importance of allowing sufficient time to elapse between operations, for shrinkage, stretching and natural adjustment to take place. If this is done we will find many difficult problems partially solved for us.

removes the breast tissue. Absolute hemostasis is essential, and after this has been secured, a firm pack is inserted into the cavity. He then removes from the abdominal wall, the buttock or the thigh, a mass of fat one-half larger than the breast tissue which has been extirpated (to allow for subsequent shrinkage) and fills the breast cavity with it. He closes the wound without drainage.

Hernia of the Lung.—The plastic surgeon is occasionally called upon to close a defect in the bony framework of the thoracic wall through which there is a hernia of the lung. This may follow injury or operation. I have found that when a hernia protrudes through an opening involving only a comparatively small portion of one or two ribs, after freeing the overlying soft parts from the pleura, a graft of

fascia lata sutured snugly over the defect will ordinarily close it and prevent recurrence. When the lung protrudes through a larger opening (usually following wounds), the transplantation of cartilaginous ribs after separation of the overlying soft parts from the pleura, is usually the operation of choice. Chutro, Okinczyc, and others, have had good results with this method.

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CHAPTER XXIV

SURGERY OF THE EXTREMITIES

General Considerations.—The majority of plastic operations on the extremities are made necessary by extensive losses of substance, due to burns, operations, injuries or ulceration, or to the vicious cicatrices following these lesions. The destruction of tissue may occur anywhere on the extremities, but in certain situations it is of more importance than others, especially at the junction of the limbs with the body, in the neighborhood of the joints, on the sole of the foot, and the palm of the hand.

Vicious cicatrices are due for the most part to slow unassisted healing and the formation of an extensive amount of scar tissue, the part having assumed the most comfortable natural position. In due time the scar contracts, hyperflexion or extension occurs, and the parts may be bound so closely together that for all practical purposes they are fused into one mass. The motion of involved joints may be partially or completely limited, and the part become useless. The underlying soft parts may be atrophied by long continued pressure, and often the bone is shortened and distorted. These contractures require radical treatment.

In the neighborhood of joints such as the knee, elbow, ankle, the palm of the hand, and sole of the foot, a thick soft resistant skin is necessary. As a general rule after the relief of flexor contractures, the part should be kept *in extension* until the grafts or flaps have healed, and *in flexion* after extensor contractures.

TREATMENT OF LOSS OF SUBSTANCE

The Use of Abduction.—Parker and others treat extensive burns of the axilla, arm, and adjacent portion of the chest wall, by abducting the arm and maintaining this position with a plaster cast which is removed for purposes of cleanliness each day. After the sloughs have come away, the wound is covered completely with overlapping strips of adhesive plaster which are changed every two or three days, this type of dressing being continued until healing is complete. By the

use of this method it is said that no contracture occurs, and that the necessity for skin grafting is eliminated. It can also be used on the neck and thigh where they join the body. My experience has been that the results with this method are much accelerated by the use of skin grafts.

The Use of Skin Grafts.—Skin grafts may be placed on a fresh wound or on a clean (sterile) granulating surface, with equal success,



FIG. 745.—Congenital cavernous hemangioma involving the upper extremity and chest (Surg. No. 29316).—Anterior view. There was pain and loss of function. X-ray showed atrophy of the bones and calcified areas scattered through the soft parts. The pectoral muscles were involved and huge blood channels penetrated the chest wall. The case was found to be inoperable.

and are very useful in hastening the healing of extensive wounds. By their aid contractures may in many instances be prevented; in others even if a certain amount of contracture follows, it is much less difficult to correct than if healing has taken place unassisted.

On wounds away from joints any of the types of skin grafts may be used with satisfactory results. If the loss of substance is over a joint for instance in the cubital or popliteal spaces, we must select the type

of graft under which contracture is least likely to occur. Ollier-Thiersch grafts are often used, but as contracture frequently takes place beneath a graft of this type, it is more satisfactory to use whole-thickness skin in these situations. I have seen some good results with small deep grafts around the elbow, wrist and knee, but this type is not to be recommended in these situations, as contracture often takes place after healing.



FIG. 746.—(Surg. No. 29316), *continued*.—Posterior view of hemangioma involving the upper extremity.

Other Methods.—Occasionally gliding flaps may be used (French method). The Indian method is suitable in certain situations, but frequently the condition of the surrounding tissue and the situation of the wound contraindicates the use of a flap from neighboring tissue.

The procedure of choice, when a thick pad of fat and skin is required under which no contracture will occur, is the flap from a distant part (Italian method).

TREATMENT OF VICIOUS CICATRICES

Excision, or Division, with Skin Grafting.—After cicatrices have formed the best method of treatment is to excise, if possible, all of the contracting scar. If the defect left by this excision is not in the neighborhood of a joint, it may be successfully treated with any of the types of skin grafts. On the other hand, if the defect is close to a joint, my experience has been that grafts of whole-thickness are to be preferred. If the scar involves too large an area for complete excision wherever it is situated, it should be divided, the contracture relieved, and the defect filled with a graft of whole-thickness. In this way the continuity of the scar is broken with a mass of tissue which will stretch in due time; the relaxation will change the character of the remaining scar so that it will become more stable, and if properly massaged and manipulated will answer very well, without further operative interference.

The Use of Pedunculated Flaps.—In the neighborhood of joints or in exposed portions, either after complete excision of the cicatrix or after a simple division, the most dependable results are secured by the use of pedunculated flaps of skin and subcutaneous fat from a distant part. In using a flap from a distant part every effort should be made to place the patient in a comfortable position. This is a comparatively simple matter when a flap from the abdomen is sutured to the arm, but when the flap is from one lower extremity to the other the problem becomes difficult. In all cases in which the limbs have to be fastened together, it has been found by experience that it is ordinarily more comfortable for the patient if the shoulders and buttocks rest on the bed. A position must be determined with the coöperation of the patient which is comfortable, and if possible exactly this same attitude assumed and maintained after the flap is in place, and the immobilizing plaster cast has been applied. A slightly greater degree of rotation may make intolerable a position which otherwise would be fairly comfortable. It is a difficult matter to apply an immobilizing dressing to a patient relaxed by a general anesthetic, which will be comfortable after consciousness returns. To provide for this a cast may be fitted on a day or two before operation with the parts in the desired position, and it may subsequently be cut and removed. Then at the time of operation after the flap has been sutured into position, the cast may be replaced. The successful use of such a cast, however, is a questionable matter, as the necessities of the operation often require

changes in the previously calculated length of the pedicle or in the angle in which the part is placed.

Nélaton and Ombrédanne have suggested that the sound leg be placed in the desired position in a removable plaster cast which is so cut that the proposed flap will not be interfered with. Then, when the flap is subsequently raised, the cast is reapplied and used as a fixed point, so that the cast to hold the limbs together can be more easily and comfortably applied. This is a very useful procedure.

Great care must be taken that skin should not be in contact with skin. The use of powder and properly placed gauze pads will prevent

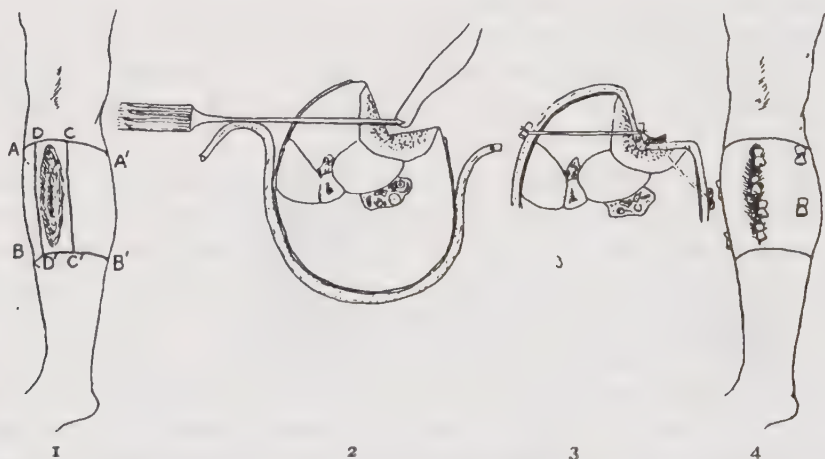


FIG. 747.—Method of closing bone defects with sliding skin flaps (Thévenard).—1. The dark lines AA' and BB' indicate the upper and lower incisions marking out the flaps of skin and subcutaneous tissue. DD' and CC' indicate the incisions by which the skin and periosteal margins of the bone defect are removed. 2. Cross section showing the healthy bone after operation. The drill passed through the muscle has perforated the bone, and has been threaded with silver or bronze wire. 3. The skin flaps have been shifted inward and fixed in the bottom of the groove in the bone. Note that the wires are tied over gauze rolls. 4. Appearance of the leg after suturing is completed. Note the alternating position of the sutures.

this. All bony prominences must be carefully padded and thick pads should be placed between the limbs when they cross, or when one rests on the other. It is better to over-pad than to under-pad, as a pressure sore is a disgraceful and unnecessary complication. The ankle, knee, or heel, where they rest on the bed must also be thoroughly padded. The flap should be inspected from time to time.

METHODS OF OBLITERATING BONE DEFECTS

The defects left by the removal of portions of the long bones for osteomyelitis are often difficult to heal. Grafts may be placed on the

bone itself or, if granulation tissue forms on the surface of the bone, this area may be grafted, after the proper preparation.

If the surrounding skin is normal to the margin of the bone defect, then after the bone has been thoroughly cleaned out, lateral flaps may be shifted in by the French method, and their edges secured to the bottom of the gutter by tacks with lead plates, wire staples, or sutures. The operation of Trévenard is a very good one and, with modifications in the method of securing the flaps to bone, may be used on upper or lower extremity. The diagrams of this procedure are self-explanatory (Fig. 747).

Pedunculated flaps from the adjacent skin, or from distant parts may also be used to fill the defect, and may be held in position by sutures, tacks, or by the dressings alone.

It may be necessary to relieve the tension or to excise the scar if the wound is also surrounded by scar tissue, before satisfactory healing can be obtained by any method. A tight, thin scar immediately surrounding a bone defect (as in any other situation) is always a source of trouble.

UPPER EXTREMITY

ARM AND ELBOW

Loss of Substance.—In treating wounds around the elbow healing must be accelerated by the use of grafts or flaps, as seems best for the special case. It is often advisable to excise an ulcer in this region and to treat the gap as a fresh wound. Ordinarily in treating an extensive loss of substance—let us say of the cubital space—we should place the arm in extension and keep it in that position until healing is complete.

Contractures.—In cases in which the destruction of skin has involved the entire arm, with or without adherence to the chest wall we often find in addition to the ordinary tight scar, at one point—usually at the middle or at the junction of the middle and upper third—a definite constriction from 2.5 to 5. cm. (1 to 2 inches) wide. Often this rigid band compresses the soft parts beneath, so that the size and outline of the bone can be seen. Relief of the constriction may be brought about by dividing the scar parallel to the length of the arm down to normal tissue in one or more places, and when this has been accomplished the gap is filled with skin grafts, or better still with a flap from the shoulder. This may be done before or after the separation of the arm from the trunk.

Contracture of the elbow is usually on the flexor side, although

occasionally a dense scar over the extensor surface will prevent flexion. In this situation as in all others around joints, the problem is

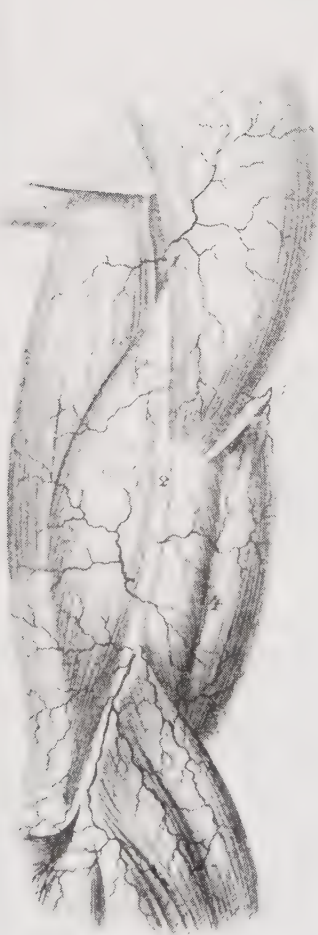


FIG. 748.

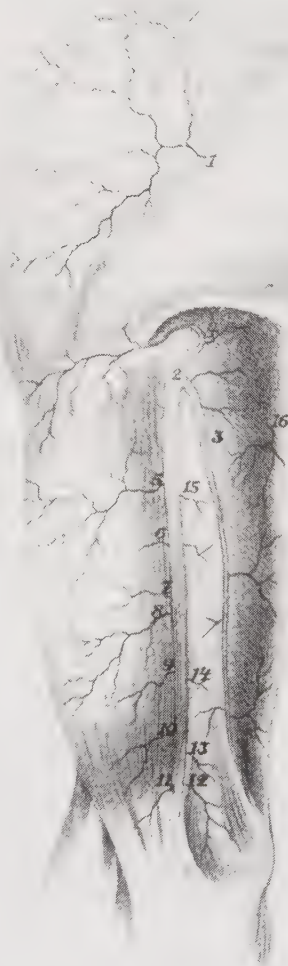


FIG. 749.

FIG. 748.—Arteries of the skin of the posterior surface of the arm (*Manchot*).—1. Posterior circumflex artery. 2. Radial recurrent artery with its cutaneous branches. 3 and 4. Cutaneous branches from the brachial artery.

FIG. 749.—Arteries of the skin of the anterior surface of the arm (*Manchot*).—1. Anterior circumflex artery. 2. Brachial artery. 3. Inferior profunda artery with its cutaneous branches. 4-15. Cutaneous branches of the brachial artery. 16. Cutaneous branches of the superior profunda artery.

usually complicated by the presence of dense scar involving the arm and the forearm.



FIG. 750.

FIG. 750.—Arteries of the skin of the anterior surface of the forearm (*Manchot*).—1. Brachial artery. 2, 3 and 4. Cutaneous branches from the brachial artery. 5. Superficial cubital branch of the brachial artery. 6. Radial artery. 7. Cutaneous branches of the radial recurrent artery. 8. Cutaneous branches of the radial artery. 9. Cutaneous branches of the ulnar artery. 10, 11. Cutaneous branches of the ulnar artery.



FIG. 751.

FIG. 751.—The arteries of the skin of the posterior surface of the forearm (*Manchot*).—1. Recurrent interosseous artery. 2-12. Cutaneous branches of the posterior interosseous artery. 13 and 14. Cutaneous branches of the ulnar artery. 15-17. Cutaneous branches of the anterior interosseous artery. 18. Radial recurrent artery. 19, 20. Cutaneous branches of the radial recurrent artery. 21. Posterior interosseous artery. 22-27. Cutaneous branches of the posterior interosseous artery. 28. Ulnar artery. 29, 30. Cutaneous branches of the ulnar artery.

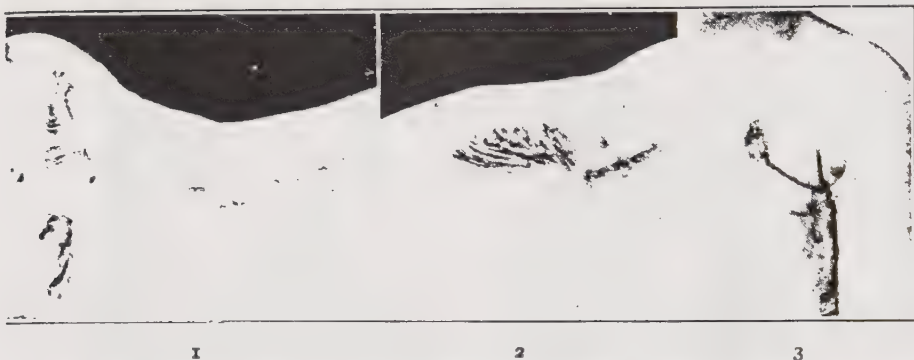


FIG. 752.—Web binding the arm and chest wall together, following a burn.—1 and 2. Anterior and posterior views. Note the limit of abduction. The deformity was corrected by removal of the scar tissue and shifting in a flap from the anterior wall, and one from the posterior wall, and suturing them in the midline. All areas not covered by the flaps were grafted. 3. Result of the operation. Note the level of the axilla in front. The dark area on the chest is the area which was grafted.

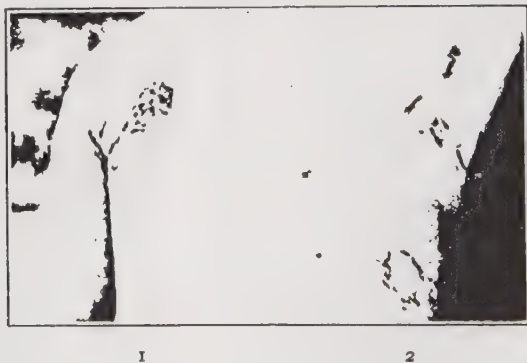


FIG. 753.—Web binding the arm, *continued*.—1. The level of the axilla posteriorly. The dark area is grafted. 2. The new axilla covered with normal movable skin. Note the width of the flaps forming the axilla, and the amount of abduction. The functional result is perfect.

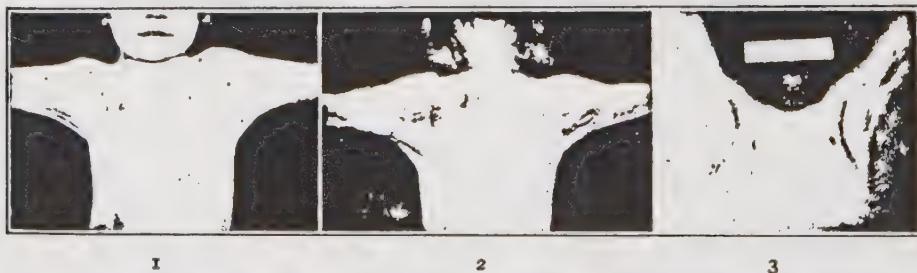


FIG. 754.—Bilateral web formation following an extensive burn.—1 and 2. Front and back views, showing the limit of abduction. Note the scar involvement of the surrounding skin. 3. The webs were fairly thin and were utilized in making flaps to form the new axillæ. Denuded areas were grafted. Photograph taken five years after operation. Note the normal appearance of the axillæ and the abduction. The functional result is also perfect.



FIG. 755.—Method of using long double-pedicle flaps (Croft).—1. Shows the contracture. The dotted lines indicate the flaps A and B which are separated from the under-
 es without cutting the pedicles. Later the lower pedicle of each flap is severed and the flaps are shifted to fill defects left by relieving the contracture. 2. Indicates the



FIG. 756.—Obliteration of the cubital space with scar, following an old burn.—1. Note the limitation of extension caused by the web, which extends from the shoulder to the wrist. 2. The result six months after operative interference.

Limitation of motion may be slight when caused by a narrow band of scar, or it may be complete, the cubital space being obliterated and the forearm and arm in this region fused together by a dense scar.

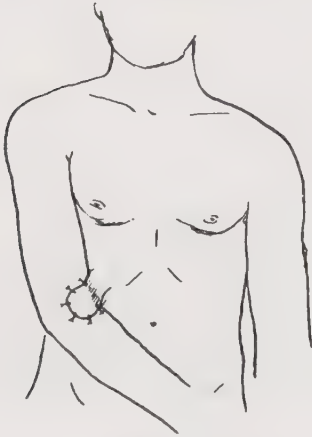


FIG. 757.

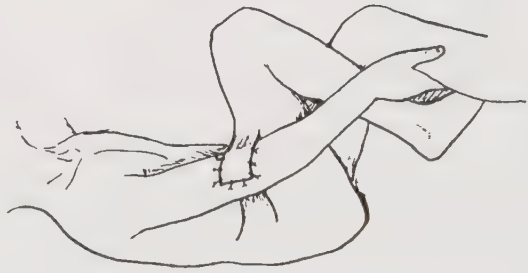


FIG. 758.

Methods of reconstructing the cubital space.

FIG. 757.—Poncet's operation.—A single-pedicled flap with pedicle above from the thoracic wall is used.

FIG. 758.—Berger's operation.—A single-pedicled flap from the thigh is used.

When the constricting bands are thin, and the surrounding skin is normal, much can be accomplished by a V-shaped incision which relieves the contracture, or by the excision of the band through a



FIG. 759.—Method of restoring the cubital space by means of a pedunculated flap from the abdominal wall. Note the position of the pedicle.

Z or S-shaped incision, and then suturing the edges. When the scar is more extensive, it must be removed and the gap filled with a graft of whole-thickness skin, or a pedunculated flap. If the scar is dense and

involves the surrounding skin it should be divided over the joint, and the contracture relieved, then as much as may be desired should be removed from the margins, and the defect filled with a graft, or with a pedunculated flap.

A flap may be obtained from the skin of the thorax (Poncet and others), or from the abdominal wall on the same side (Berger and others). When the skin of the thorax and abdomen is infiltrated

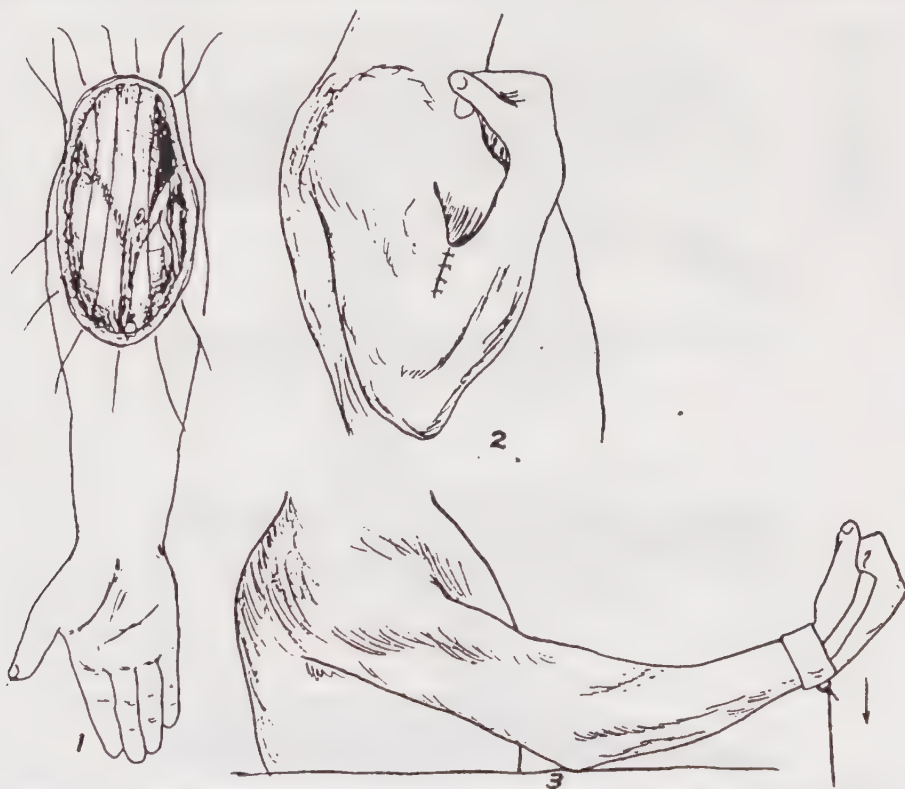


FIG. 760.—Gradual stretching of the tissues (*Morestin*).—1. The ulcer or scar has been excised and normal tissue is everywhere exposed. The sutures may be seen. 2. Position of flexion after suturing normal tissue to normal tissue. 3. Stretching the skin after healing is complete.

with scar, Berger utilizes the skin of the thigh, but the position must be extremely uncomfortable, and in these cases a graft of whole-thickness should be tried first.

Flaps from the same situation may also be used to cover the elbow after relief of extensor contractures.

Excision and Suturing of Normal Tissues With the Part in Hyperflexion.—*Morestin* has devised another method and has reported

good results. He excises the ulcer or contracture completely until normal tissues are exposed everywhere, and then hyperflexes the part and coapts the skin with sutures. After primary healing has taken



FIG. 761.—Unstable scar involving the tendons, following the explosion of aluminium bronze powder. Duration two and a half years.—1. The tightly adherent unstable scar of the forearm which prevents all motion of the fingers and wrist. 2. The area was excised and a broad pedicled flap from the abdominal wall was implanted. The view in the photograph is from above downward, the chest wall being below and the forearm across the body. 3. The result of the implantation. 4. The abdominal flap was not sufficiently wide to cover the tendons so the normal skin on the other side of the forearm was shifted over in two flaps to fill the defect, and the raw surface was covered with small deep grafts. This is an unusual case, inasmuch as although the patient was apparently well nourished there was absolutely no subcutaneous fat on the abdominal wall. The ultimate result has been satisfactory. Function is much improved, and there is no further tendency to ulceration.

place the part is gradually extended, and he says that in due time normal extension can be secured by the gradual stretching of the skin. He has utilized this method at the junction of the thigh with the body,

and in the popliteal and cubital spaces. In my experience this operation is not entirely satisfactory, unless the excised area is comparatively small.

FOREARM

Loss of Substance.—Destruction of tissue on the forearm may follow injury, burns, ulceration or operation. The treatment depends to a large extent on the size, situation and shape of the defect, and the



FIG. 762.—Contracture following burn of the forearm and wrist of a child aged fourteen years. Duration twelve years.—1. There is shortening of the forearm and bowing of both bones, with flexion of the wrist and marked outward deflexion due to dense scar tissue. 2. One month after excision of the scar and the implantation of a pedunculated flap of skin and fat from the abdomen. 3. One year later. The wrist is now in normal position; the radius and ulna are practically straight, and function is much improved. Note the size and splendid condition of the flap. If necessary the marginal scar can be made less noticeable later, by excision.

condition of the surrounding skin. For instance, if the defect is parallel to the length of the forearm, is not too wide, and the surrounding skin is normal, it may be closed by undercutting and sliding, either with or without relaxation incisions. Skin grafts or pedunculated flaps may be used in suitable cases.

Contractures.—Tightly adherent scars of the forearm may be most difficult to handle on account of the frequent involvement of the tendons in the scar. In these cases the scar tissue should be carefully dissected out, and the wound covered with a pedunculated flap of fat and skin from the abdomen.

If the defect is on the extensor surface the forearm may be passed under a double-pedicled bridge flap from the abdominal or the chest wall. A

similar flap from the back may be used if the flexor surface is defective. I prefer a broad single-pedicled flap from the abdominal or thoracic



FIG. 763.

Suggestions for the use of bridge flaps from the thigh.

FIG. 763.—For the back of the forearm.



FIG. 764.

FIG. 764.—For the cubital space.



FIG. 765.—Method of using a bridge flap from the arm for covering a defect on the back of the wrist (*v. Hacker*).

wall, for the relief of defects whether on the flexor or on the extensor surfaces, and have had good success with them. I have in this way

relieved contractures involving the entire length of the forearm with single flaps from the abdominal wall. The pedicle may be above or below, according to the requirements of the case. Skin grafting may also be used with success in selected cases.

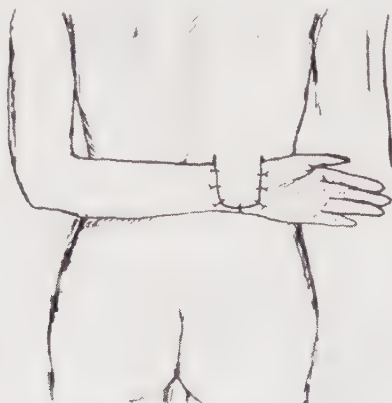


FIG. 766.

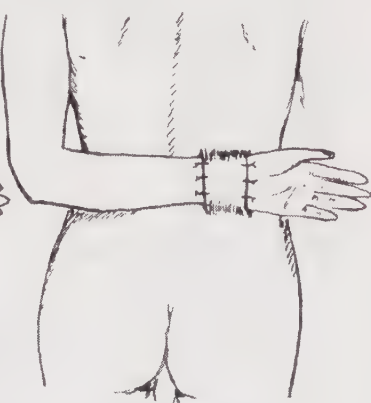


FIG. 767.

The repair of defects on the front of the wrist.

FIG. 766.—A single flap with pedicle above.

FIG. 767.—A double-pedicled flap.

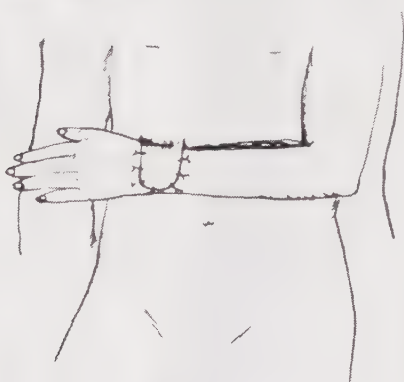


FIG. 768.

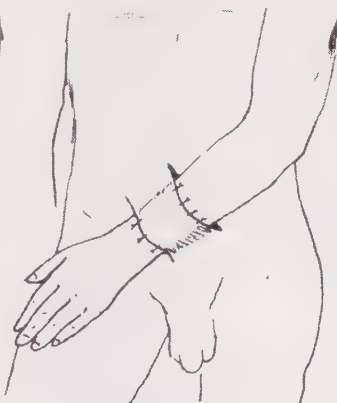


FIG. 769.

The repair of defects on the back of the wrist and forearm.

FIG. 768.—A single flap from the thoracic wall with pedicle above.

FIG. 769.—A double-pedicled flap from the abdominal wall.

Volkman's ischemic contracture will not be considered here as it is essentially an orthopedic problem.

WRIST

Loss of Substance.—In the early treatment of wrist defects contracture must be avoided by over-correction, and healing must be hastened by skin grafting.

Contractures.—After contracture has taken place I have had success follow thorough division of the scar, especially on the ulnar side,

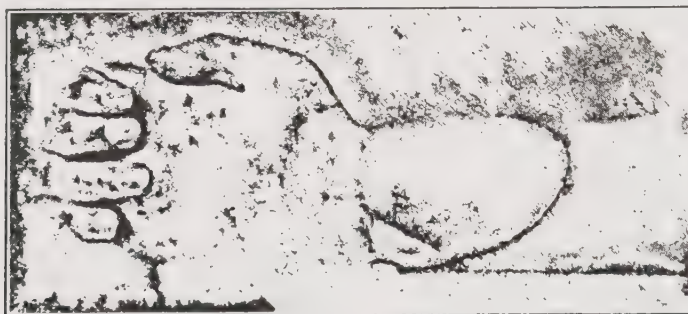


FIG. 770.—Contracture of the fingers following a burn due to electricity.—There had been an extensive burn of the palm and wrist with tendon destruction and complete scar involvement. Note the position of the fingers which are rigidly flexed. The thick pad of skin and fat implanted on the wrist is for the purpose of forming fat channels through which the newly formed or lengthened tendons may run.



FIG. 771.—Tight gauntlet scars of the hand and wrist following a burn. Duration six months.—The tightness of the scar around the wrist prevented proper function of the joint, and also held the thumb in marked abduction. In order to release the thumb a transverse incision down to normal tissue was made across the wrist at the base of the thumb, and a longitudinal incision was made along the ulna side of the wrist. Both of these incisions gaped quite widely and were filled with whole-thickness grafts. The photographs taken after two weeks show the grafts healed and the amount of flexion possible for the thumb. The function of the wrist and thumb have steadily improved since operation. The grafted areas can be seen in 2 and 3.

until all contracture was relieved. The defect was then filled with a graft of whole-thickness skin. A similar result may be obtained

with a pedunculated flap, but the simpler procedure should be tried first.

The wrist may be passed through a double-pedicled bridge flap on the abdominal, chest wall, or back, according to the situation of the lesion, or a single-pedicled flap from the same localities (Tuffier, Rochard and others) with pedicle above or below, may be used with success.

The forearm or wrist may be passed through a bridge flap on the thigh, but the position is awkward and this region should not be used unless the others are unavailable.

Some of the wrist contractures show extensive flexion or extension and in old cases where the shape of the articulating surfaces has been



FIG. 772.—Method of using a wire cage over a grafted area on the thumb.—Note the distance the wire mesh is held away from the wound by the felt pads, and its use as a splint. Also the rubber impregnated material holding the graft in place.

distorted it may be impossible to restore function completely, even when all tension has been relieved.

HAND

Loss of Substance.—On the back of the hand the defect may be covered with skin grafts of any type, but preferably with large grafts as the scarring is less noticeable. On the palm the only type of graft which promises permanent results is of whole-thickness. When the destruction is deep, pedunculated flaps should be used on the dorsum or palm of the hand. A reasonably thick flap on either palm or dorsum in due time, will shrink and be very little thicker than the normal surrounding skin.

Contractures.—These may vary in extent from that of any portion to complete involvement. The flexor type is the most common.

Horrible deformities due to cicatricial contractures are found on

the hand, and the effect of the distortion is unbelievable unless seen. After the contracture has been relieved, if skin grafting is decided on, only the whole-thickness graft should be considered, as recontraction

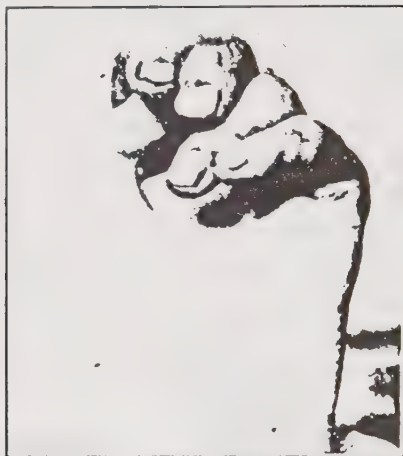


FIG. 773.—Contracture of all the fingers following severe infection treated by multiple incisions.—In this case the only method of treatment promising relief would be the implantation of a pedunculated flap into the palm and wrist. Then the lengthening or reconstruction of the tendons.

will often occur when other types are used. I have had good success with this method in the relief of contractures on the dorsum and on the palm of the hand and fingers, and several years ago reported a number of cases treated by this method.¹



1

2

3

FIG. 774.—Contracture of the hand following a burn. Duration twenty years.—1 and 2. Note the limit of extension. The flexion of the little and ring fingers is especially marked and atrophy has occurred. 3. After relief of the contracture a pedunculated flap from the abdominal wall with pedicle above, was implanted. Photograph, (from above), taken two weeks later and just before the pedicle was cut.

The use of the pedunculated flap from the thoracic or abdominal wall (Berger, Fontan, Murphy and others), or from the back, buttock,

¹ Davis, J. S., "Surg., Gynec. & Obst.," July, 1917, 1.

or thigh, may be used to cover a defect on the dorsum or palm of the hand according to its situation.

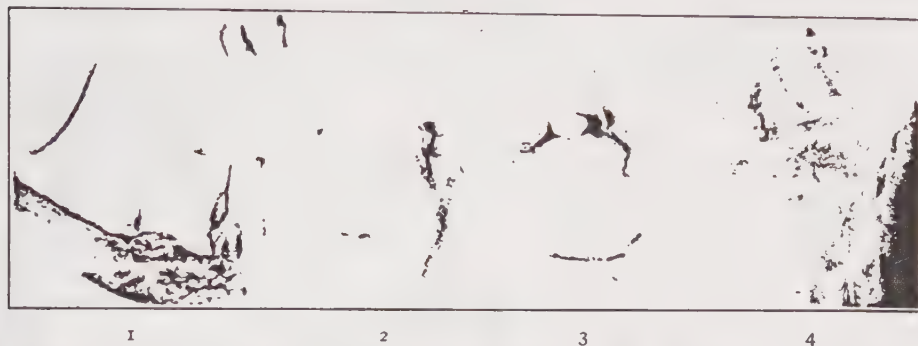


FIG. 775.—Contracture of the hand, *continued*.—1. The position and width of the pedicle can be seen. Photograph taken just before the pedicle was cut. 2 and 3. Taken two weeks after cutting the pedicle. Note the very thick pad of fat and the excessive amount of skin. 4. Taken eight months later. Note the shrinkage in the flap and also the amount of extension possible. This flap is to be left in place some time longer and massage and passive motion continued on the fingers, in order that the joint surfaces may gradually adjust themselves, as there has been considerable distortion during the long continued flexion. Later a portion of the fat will be removed from the flap, and excess skin will be utilized on the flexor surface of the proximal phalanges of the middle, ring and little fingers. The gradual readjustment of joint surfaces, and the stretching of the ligaments in these cases is most important if normal function is to be obtained.

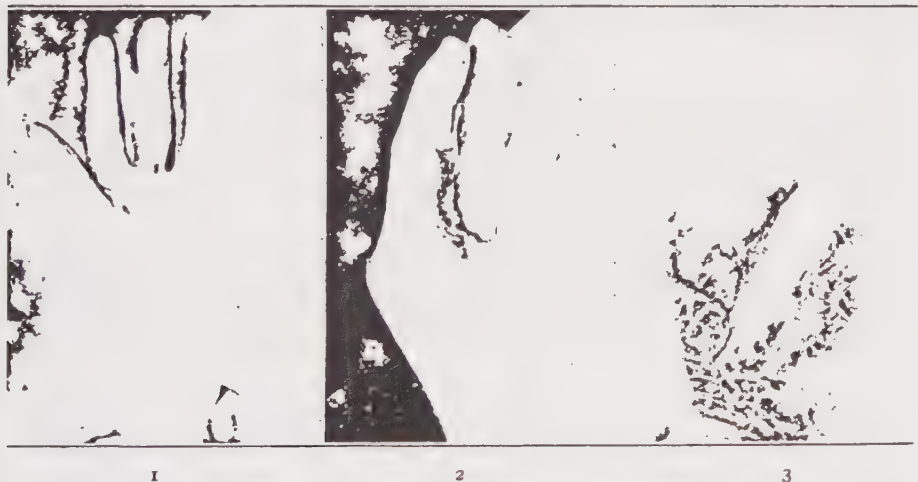


FIG. 776.—Contracture of the hand following a phosphorus burn. Duration three years.—1 and 2. The limit of extension. This completely incapacitated the patient for his work. An unsuccessful attempt was made to relieve the condition with a whole thickness graft. 3. Two weeks after the implantation of a flap from the abdominal wall. Note the raw surface left after cutting the pedicle. This was fitted into position.

Morestin used the lax skin of the opposite breast to cover defect on the dorsum of the hand, and Ombrédanne obtained a flap from the opposite forearm near the elbow for covering a defect in the palm.

The flaps (depending on their situation) may be of the double-pedicled bridge variety, or the pedicle may be single, with attachment above or below.



FIG. 777.—Contracture of the hand, *continued*.—1 and 2. Taken one year after the implantation of the pedunculated flap. Note the relief of the contracture and the ability to extend the thumb. 3. Taken two and a half years after operation. The flap has flattened out completely and is soft and resistant. The function of the hand is practically normal.

W. T. Bull, in 1888, used the same bridge flap for covering the dorsum and palm. He placed the denuded hand under a long bridge flap raised from the chest wall, keeping the palmar surface from adhesion to the underlying tissues by gauze (rubber protective or par-



FIG. 778.

FIG. 779.

FIG. 780.

Single-pedicled flap to repair defects of the palm of the hand.

FIG. 778.—From thoracic wall.

FIG. 779.—From the abdominal wall.

FIG. 780.—From the opposite forearm.

affined linen are preferable). After 12 days the lower end of the flap was divided and folded around the hand to cover the palmar surface, and 12 days later the upper pedicle was cut and used to cover the rest of the uncovered area. This method with modifications is well worth

considering. In my own work I prefer the gradual division of the pedicle in cases where the flap is so long.

Utilization of Metacarpal Bones in Formation of Movable Stumps.

—In lacerated and crushing wounds of the hand every particle of tissue should be conserved. A useful hand may be fashioned out of very unpromising material.

The thumb is the most useful digit, and Klapp was able to make a good working stump after traumatic amputation of the metacarpo-



FIG. 781.—The effect of transplantation of a pedunculated flap from the abdomen into an area from which the scar tissue had not been completely removed. The operation was done several years before the patient came under my care. The condition of the flap on the outer side of the thumb and wrist was excellent, but the scar tissue beneath it has interfered with the growth of the thumb and with its function. Better function was obtained by excision of the scar tissue at each end and shifting the position of the flap.]

phalangeal joint. He separated the metacarpal bone of the thumb by dividing the tissues between it and the adjacent metacarpal bone, and covered the surfaces with skin flaps. This skin may be obtained from the neighborhood or from a distance.

Lyle made a short useful thumb in the same way after covering the raw surface of a denuded hand with an abdominal flap.

It is advisable to suture the tendons over the ends of the metacarpals when amputation has been necessary, as in this way better motion is assured.

Burkhard carried Klapp's procedure further. In addition to the

formation of a thumb stump, in a case in which all the fingers had been destroyed down to the metacarpophalangeal articulations, he made three movable stumps by cutting down between the metacarpals and covering all raw surfaces with sound skin. In these operations

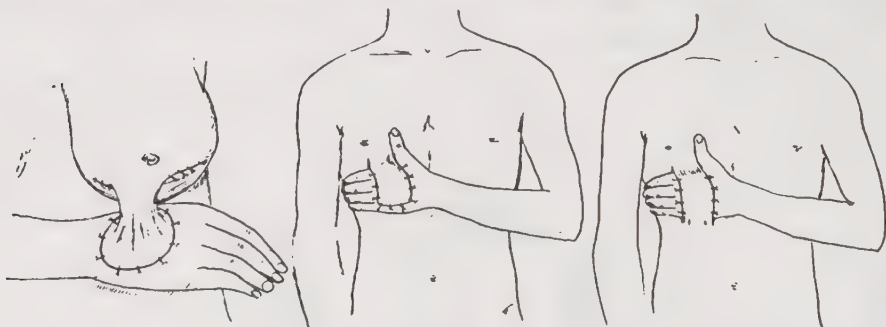


FIG. 782.

FIG. 783.

FIG. 784.

The use of pedunculated flaps to repair defects on the back of the hand.

FIG. 782.—Morestin's method.

FIG. 783.—A single flap with pedicle above, from the thoracic wall.

FIG. 784.—A double-pedicated flap from the thoracic wall.

care should be taken to avoid injuring the thenar muscles. In this way a thumb stump may be formed which can be approximated with the uninjured fingers, or with other stumps, and will go to make a fairly useful hand.

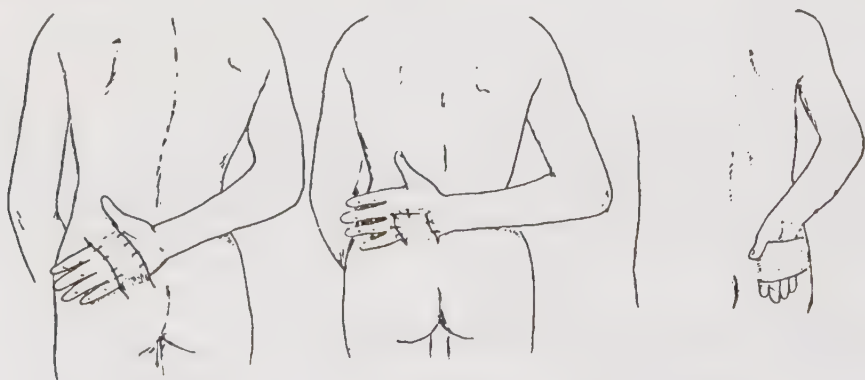


FIG. 785.

FIG. 786.

FIG. 787.

Single and double-pedicated flaps from the back and buttock to repair defects in the palm of the hand.

FIG. 785.—A double-pedicated flap from the buttock.

FIG. 786.—A single-pedicated flap from the back.

FIG. 787.—A double-pedicated flap from the buttock.

The Use of Free Bone Grafts and Pedunculated Flaps of Skin to Form Opposition Finger Stumps.—In two cases in which the thumb was intact but where all the fingers and metacarpal bones had been

destroyed, Albee was able to construct an opposition stump which changed a useless extremity into a useful one.

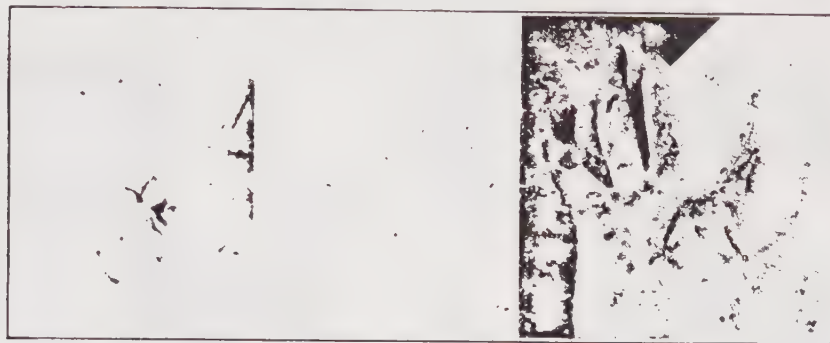


FIG. 788.—Contracture following a third degree burn. Four years duration.—1 and 2. Note the limit of extension. 3. Result five years after whole-thickness grafting. The function of the hand is perfect. Note the fingers, thumb and palm.



FIG. 789.—Contracture of the back of the hand following a burn. Duration four months.—1. The extent of flexion. It can be seen that the scar tissue on the back of the hand and fingers prevents function. The scar was excised and the denuded area was covered with a whole-thickness graft. 2. The graft occupying the upper half of the back of the hand, and the proximal phalanges of the fingers. The photograph has been trimmed too closely on the radial side to show the extent of the graft over the knuckle of the forefinger. Photographs in 2 and 3 were taken two years after grafting. 3. A fist can be made without difficulty, and function has been restored. The patient, who is a presser by trade, has been able to continue his work since discharge from the hospital eight years ago.

In one case a folded pedunculated flap from the chest wall supplied the soft parts, and four weeks later the pedicle was cut from the chest

and a tunnel was made through the flap down to the os magnum. A tibial graft was then driven into a mortise in the os magnum and the soft parts were closed over it. In the other case the flap was obtained

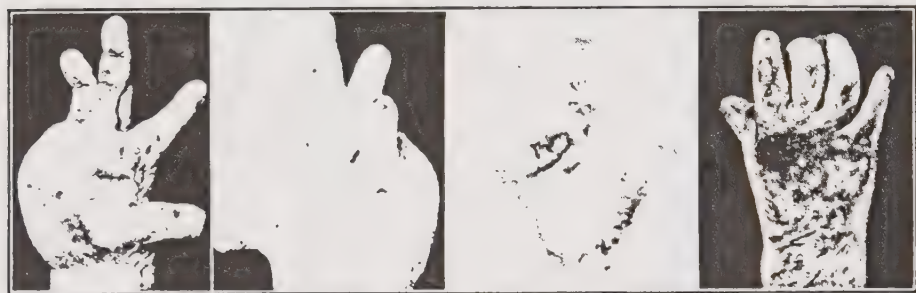


FIG. 790.—Contracture of the hand following a burn. Duration one year.—1 and 2. Plaster casts showing the condition before operation. Note the absolute helplessness of the hand. 3 and 4. Taken twenty-two months after the relief of the contracture and the transplantation of whole-thickness grafts. Compare the positions of the fingers with those before operation. The function is excellent. Note in 4 the large size of the graft occupying the entire back of the hand. This case could also have been successfully treated by means of a pedunculated flap from any suitable locality.

from the shoulder and the bone from the clavicle. The formation of the soft parts and the bone transplantation being done at the same time. The bone was driven into a mortise in the stump of the third

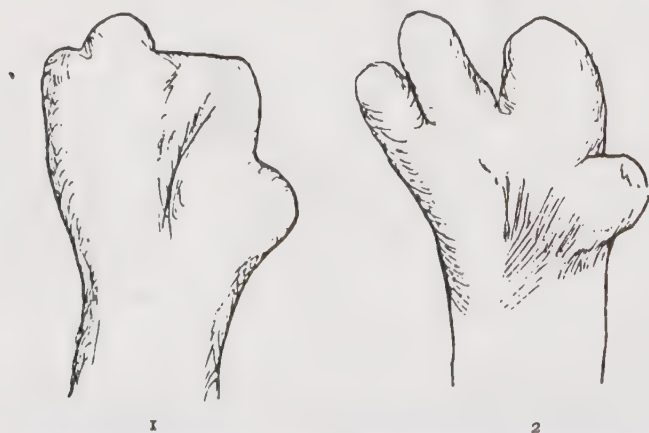


FIG. 791.—Method of rebuilding a hand (*Burkard*).—1. The stump of the hand left after destruction of the thumb and fingers by freezing. 2. Finger-like stumps formed from the metacarpal bones covered with skin.

metacarpal bone, and the flap was sutured around it. About four weeks later the pedicle was cut from the shoulder and the stump was shaped.

The results in the short time which has elapsed since the operations were done have been good, and a useful hand has been provided in each case. It is too early to determine whether the active function in this situation will prevent atrophy of the bone. Ordinarily a bone transplant in contact with bone at one end, and extending into the soft parts, without special function, will eventually be absorbed.

Should the ultimate result in these cases be satisfactory, there is no reason why the same procedure should not be employed to form a thumb stump to oppose any finger or fingers which are intact.



FIG. 792. —Misplacement of the little finger and ulnar deflection of the hand, following a burn of many years duration.—1. Note the position of the hand and little finger. X-ray showed that the condition of the joint precluded the restoration of function of the finger 2 and 3. The skin of the finger was preserved as a pedunculated flap after removal of the phalangeal bones, and was used to fill in the defect after relaxing the tightly drawn scar from the ring finger to the wrist. A transverse incision was made across the wrist and this defect was filled with a whole-thickness graft. The lower margin of the photograph passes through the lower portion of the graft. Function is much improved and the hand is gradually assuming a more normal position.

THE FINGERS

Loss of Substance.—Skin grafts may be used with great satisfaction in certain instances. For extensive loss of soft parts of the thumb or finger without bone destruction, bridge flaps (Haubold and others) have been used, and later the size of the finger reduced by trimming operations. A single-pedicled flap may also be used for this purpose.

Flaps from Injured or Contracted Fingers.—Following certain fresh wounds the injury to the bones of one or more fingers may be obviously

such that after healing is complete the finger would be useless. In these cases a flap of good skin of considerable size may often be obtained by removing the bone and saving all the viable skin covering the finger. By the utilization of such a flap a more stable healing will be obtained and quite extensive losses of substance may be covered, thus giving a firmer and quicker healing, and preventing the formation of scar tissue. A similar procedure may be carried out when the wound is granulating. I have taken advantage of this method in utilizing the normal skin on fingers which were so distorted by contracture as to make their replacement impossible.

Method of Lengthening the Finger by the Stimulation of Granulations in a Celluloid Tube.¹—It is often possible to add length to the terminal phalanx after loss of tissue in finger injuries, and I have found a celluloid tube useful for this purpose.

When a partial traumatic amputation of the terminal phalanx of a finger takes place, one of two conditions is found: either the part is cut away clean with little damage of the remaining portion, or the part is crushed off, and the tissues adjacent to the amputated portion are more or less traumatized.

After the ordinary healing by granulation, we frequently find a sensitive stump, the bone being covered only by a thin scar. The question arises as to the best method of early treatment, especially when the bone is exposed.

In order to obtain a good functional result we must contrive to place a pad of tissue over the bone. This may be done rapidly and satisfactorily by shortening the exposed bone and closing the soft parts over it, but this method gives a shorter stump.

In certain occupations the loss of all or a portion of the terminal phalanx of a finger is a matter of considerable economic importance to the skilled worker. It is often advisable to preserve the remaining length of the finger, and if possible to replace the loss of tissue, thus giving a more useful and less painful stump, and at the same time one which is less disfiguring.

One should always replace the amputated portion unless it is too much traumatized, or unless more than three or four hours have elapsed between the time of the accident and the first treatment. This procedure is attended with little danger, and if the replaced portion does not regain its vitality it can be easily removed, and the building up process then inaugurated.

¹ Davis, J. S., "Jour. Amer. Med. Assn.," May 15, 1915, 1647.

The majority of the patients with these injuries are treated in the out-patient department. Hence the use of pedunculated flaps from the thoracic or abdominal wall was contraindicated, and a method had to be used which would give good results without necessitating admission to the hospital.

The most promising procedure seemed to consist in stimulating the growth of granulation tissue on the end of the stump, and in some way to confine the growth to the desired size and direction. After a number of experiments I found that a sheet of celluloid $\frac{1}{200}$ inch thick would be best for the purpose. This material was sufficiently rigid, transparent,



FIG. 793.—Use of the celluloid tube in lengthening the end of the terminal phalanx.—
1. A convenient pattern by which to cut the celluloid. 2. The celluloid rolled into a tube
3. The tube in place, partially filled with a blood clot; patient seen shortly after the accident. 4. After removal of the tube; the line of the amputation can be seen, and above it the moulded clot. Note the snug fit of the tube in 3, and the clearness with which the skin can be seen through it.

non-adherent, and could be cut in a shape which when rolled, formed a tube adjustable to the size of the finger.

G. W. Meil advised in partial traumatic amputation of the terminal phalanx that the granulations be stimulated and then molded by means of adhesive plaster, but this material has proved much less satisfactory than the celluloid tube.

TECHNIC.—The stump is painted with tincture of iodine. The shaped piece of celluloid, after being soaked in mercuric chlorid, 1 to 1000, for a sufficient time, is sponged off with ether or alcohol. It is then wrapped around the finger and secured with narrow adhesive strips, thus making a tube which is slightly smaller at its free end than at its base. When the tube is properly adjusted, it will hug closely the edge of the wound, and will gradually become larger until it impinges on the first interphalangeal joint. The celluloid may extend

as far beyond the finger tip as is needful, and in addition to its primary function it also serves as a splint for the finger, and as a protection to the wound (Figs. 793-795).

In cases seen *early*, a blood clot is allowed to form in the tube. This clot serves as a scaffold for granulations. If the soft parts are



FIG. 794.—1. Finger stump four days after the accident, before application of the celluloid tube. 2. Finger ten and one-half months after the accident. The healing was complete in thirty days. The arrow indicates the injured finger.

lacerated and spread apart, they are gathered together and held in place by the tube.

In cases seen after the granulations have started, every effort is made to stimulate their growth, and to train this growth along the tube.



FIG. 795.—1. Three days after the accident, note the clot. 2. End view of finger stump. 3. Fourteen months after the accident. The wound was healed in thirty-five days. The arrow indicates the injured finger.

Any desired medication may be applied to the wound after the celluloid is in place, either by pouring it into the tube, or by packing the tube with gauze. The dressing in this way comes in contact with the wound, and is confined by the tube. A loose gauze plug is then placed in the mouth of the tube, and over all a small dressing secured by a

bandage. In order to give an idea of the types of cases treated, I will include a summary of the first 15 cases treated by this method.

Summary.—*Number:* 15 cases, males, 13; females, 2. *Ages:* from 16 to 50 years. *Color:* white, 13; colored, 2. *Occupation:* operators on machines, 15. *Etiology:* all were injured by machines. *Situation:* right forefinger, 5; left forefinger, 4; right middle finger, 2; left middle finger, 3; right thumb, 1. *Duration of lesion before coming under my care:* from one hour to twenty-six days. *Amount lost:* from 0.75 cm. ($\frac{3}{10}$ inch) of the tip, to the entire terminal phalanx. *Amount gained:*



FIG. 796.—The use of a whole-thickness graft over the first interphalangeal joint —The joint before grafting was covered with a thin tightly stretched scar following burn, which tore constantly when flexion was attempted. The scar was excised and the first figure shows the graft ten days after transplantation. The second figure shows the amount of flexion possible, and the condition of the graft one year later.

from 0.5 to 1.25 cm. ($\frac{1}{5}$ to $\frac{1}{2}$ inch). *Type of lesion:* the nail was involved in all. In 2 there was some loss of tissue, the remaining soft parts of the terminal phalanx being mushroomed out and badly crushed, although still attached to the finger by pedicles. In none of these was the bone involved. In 13 the amputations were more or less clean cut, with little crushing of surrounding tissues, and in all the bone was involved. In 10 the lesion involved more of the dorsal than of the palmar surface. In one the skin was involved equally on both

aspects of the finger, and in two the lesion involved slightly more of the palmar surface.

TREATMENT.—The celluloid tube was used in all in addition to stimulation. In one, in addition to the foregoing, small deep grafts were used to hasten healing. *Duration of treatment:* entirely healed after 10, 21, 24, 26, 28, 29, 30, 34, 35, 36, 38, 39, 45 and 66 days, with an average of 33 days. The cases taking the greater number of days before healing was complete were those in which the wounds were seen late, and which were prevented from prompt healing in order to give more length to the stump.

RESULTS.—There was increase in length of the soft parts in all, and in four instances slight increase in the length of the bone.

There was not a single painful stump in the series. The pad of tissue over the bone was quite movable and soft in all. Voluntary flexion of the terminal phalanx was excellent in all, even when only a small amount of the phalangeal bone remained.

The celluloid tube has also been used with success as a protective dressing for other lesions of the terminal phalanx, such as compound fractures, lacerations, etc.

The method is simple, the patient can return to his home at once, and begin light work after a short time. A very small gauze dressing around the celluloid suffices. The granulations may be observed through the transparent celluloid without removal of the tube. There is sometimes sweating of the skin of the finger if the tube is allowed to remain in place for more than two or three days. The tube is easily removed, as it does not stick, and after being cleansed it may be replaced, or a fresh tube adjusted.

Thickness of the granulating area can be stimulated in various ways. As the granulations grow, the epithelium from the skin edge also grows, and often it is difficult to prevent it from closing over the stump before the desired length is obtained. In these instances the epithelial edges should be kept down with silver nitrate.

In some cases when the granulations are sufficiently advanced, it is advisable to cover them with small deep grafts, in order to give a more stable and quicker healing. In my own series I might have done better had I grafted more. The cases seen soon after the accident gave the best results, as far as an increase in length was concerned.

Building new tissue on the end of the stump is slow, but in the end it will preserve the bone which remains and cover it; it will also often add materially to the length of the stump. If the joint is not implicated

even a short bit of terminal phalangeal bone will form the basis for a shortened terminal phalanx, which may be voluntarily extended and flexed, and can be used nearly as well as an intact terminal phalanx.

From the standpoint of function, increased length, and improved appearance, the results have been better than with any other ambulatory method with which I am familiar.

Method of Lengthening the Finger by the Use of Pedunculated Flaps.—As much tissue as desired in lengthening the finger, after partial traumatic amputation, may be obtained by using a bridge or pedunculated flap from the abdominal or thoracic wall (Nicoladini, Kausch, Sievers and others), or from the thigh, but the procedure is irksome and long drawn out, and requires admission to the hospital. In order to



FIG. 797.—Contracture following a crush burn between hot rollers. Duration six months.—1. Before operation. Note the limit of extension. 2 and 3. Twenty-on months after the transplantation of a whole-thickness graft. Note the complete extension and flexion.

replace the missing bone a piece of bone (Neuhäuser) or cartilage may be implanted under the skin, and later transplanted in a pedunculated flap to the finger. In the few cases in which this is necessary my preference is for cartilage.

Contractures.—These may vary from slight flexion of one finger to complete flexion of all the fingers, and is often associated with contracture of the palm. The condition may be due to scarring of the skin alone without injury to the tendons, or the tendons may also be partially or totally destroyed. When the tendon is intact multiple division of the scar has been frequently tried, with or without the injection of fibrolysin, but in my experience the method is far from satisfactory.

I have had very good results with whole-thickness grafts (after



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FIG. 798.—Contracture following a burn by electricity. Duration ten months.—1. Before operation. 2. Ten and one-half years after grafting. The graft has been exposed to the constant trauma incident to farm work. It has increased in size as the hand has grown larger, and has preserved its own characteristics. Hairs similar to those on the thigh, from which the graft was taken, are growing on it. The graft is pigmented and wrinkled, but is soft and movable with the surrounding skin. The functional result is excellent.



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FIG. 799.—Partial syndactylism due to trauma. Duration one year.—1 and 2. Note the inability to separate the middle, ring and little fingers, and the scar involvement. 3 and 4. The result of several operations to deepen and widen the commissures. Compare the ability to separate the fingers with that before operation. In this case the flaps were more or less infiltrated with scar tissue.

completely relieving the contracted scar and excising the scar tissue), and with them I have successfully covered as many as four fingers and the adjacent portion of the palm at one time. By a "successful" result in these cases I mean a result which will stand the acid test of time, and in which recurrence will not follow after the patient has left the hospital. In all of these cases the fingers should be extended and kept in this position continuously until healing is complete, after which an apparatus should be worn at night for several months.

A large pedunculated flap may be used to cover the denuded flexor surfaces of several fingers after relief of the contracture and excision of the scar. The division between the fingers is made later after the flap has healed in place.

When the tendon is destroyed, an attempt may be made to find the ends and unite them by one of the methods previously mentioned but in case this is done a pedunculated flap should be used, as the pad of fat beneath will often prevent adhesion.

The Correction of Flexor Contractures by Multiple Lateral Flaps—Morestin has described an ingenious method of dealing with contracted scars of this type which may be used on the thumb and fingers. He divides the scar in the midline lengthways from one end to the other. Then by secondary incisions from the longitudinal incision as the axis he makes small angular pedunculated flaps, the free margin being at the longitudinal incision, and the bases sometimes on the border of the free extremity, sometimes at the side of the root of the finger, and sometimes on the palm. It is not necessary that all of these flaps should be made at first, but gradually as the need becomes evident in extending the fingers.

In this way a series of lateral oblique flaps are formed. By the formation of these flaps the finger is usually released and can be straightened; but if this cannot be accomplished any binding tissue—such as the remains of tendons and even the articular ligaments—should be divided in order to complete the extension.

After the finger has been extended the flaps are shifted in as transversely as possible, and are superimposed, those from one side alternating with those of the other. After several trials the best positions are found and the flaps secured by sutures, and the finger is extended on a splint. The small raw surfaces between the flaps soon heal.

Joint motion should be begun as soon as healing is complete. In the end voluntary flexion cannot be completely carried out, but the contraction of the interosseous, thenar, and hypothenar muscles begin

the movement of flexion of the first phalanx toward the palm, and the adjoining normal fingers carry the finger downward nearly to complete flexion. This does not give strong flexion, but corrects a vicious contracture and causes restoration of function which, while not perfect, is very acceptable. Morestin reports many excellent results. I have found this method useful, but prefer whole-thickness grafts for the purpose.

DUPUYTREN'S FINGER CONTRACTION

In 1831 Dupuytren definitely determined that the deformity which he described, was due to the contraction, shortening and thickening of the palmar aponeurosis (the *flexor tendons not being involved*). Since that time this observation has been frequently verified.

The condition belongs to adult life, being rare under 30 years of age. According to Keen several congenital cases have been reported, and recently Greig has reported such a case, but personally I have never had the opportunity to see one. It occurs more frequently in males, and one or both hands may be effected. The degree of deformity may be much more marked in one hand than in the other; in fact the disease may be well developed for years in one hand before it begins in the other. Bilateral involvement is generally the rule. When only one hand is involved, it is more apt to be the right than the left. Of 183 cases collected by Keen the right hand only was involved in 58, the left in 23, both hands in 102.

Any one of the fingers may be involved alone, but the thumb and forefinger are most often immune. The ring finger is the one most frequently attacked, after which comes the little finger, and next in order the middle finger.

Nichols reports that in 263 cases (204 of Keen's, and 59 of his own) there were 572 fingers affected as follows: 12 thumbs, 24 forefingers, 13 middle fingers, 194 little fingers, and 249 ring fingers.

When the condition is limited to one hand the fingers involved are usually adjoining, but if both hands are involved the lesions are not necessarily symmetrical. Heredity seems to have some etiological significance, a family history of similar trouble being obtainable in about 20 or 25 per cent. of the cases.

The onset is insidious and without pain. The first thing noticed is a flattened nodular induration of the palmar fascia, in or just above the transverse crease in the palm of the hand. The skin is not adherent to the nodule in the early stages, but later the fascia bands which

normally are attached to the skin become thickened and contracted, so that a puckered dimple is formed, from which a thickened band of fascia can be felt extending toward the finger. The thickening of the fascia increases, and on the finger the lateral processes, as well as the central portion of the digital fascia, are involved. The fascia extending upward toward the annular ligament of the wrist also becomes thickened, and there occurs a progressive gradual flexion of the finger or fingers toward the palm of the hand. Ultimately this flexion may become so marked as to render the hand practically useless. It is interesting that there is seldom, if ever, any sign of an inflammatory process in the development of this condition.

Etiology.—Many surgeons, among them Dupuytren himself, believed the disease to be due to local trauma. Others have attributed it to gout or rheumatism, and still others have thought it to be of nervous origin.

Robert Abbe has described Dupuytren's contraction associated with neuralgias radiating from the seat of the contraction along the arm through the branches of the brachial plexus. The pain might very well be caused by the pressure of a cervical rib, and the theory has recently been advanced that Dupuytren's contraction is always due to this cause. This may be true in some instances, but in the vast majority of cases of cervical rib Dupuytren's contraction is not present. F. H. Baetjer tells me that approximately 50 per cent of all cases of cervical rib are bilateral, and that of the other 50 per cent (unilateral) about one-half show rudimentary outgrowths on the other side. I have often seen atrophy of the muscles of the thenar and hypothenar group in patients with cervical ribs, but have not yet observed Dupuytren's contraction where cervical ribs are known to exist. In fact, since this theory was brought to my attention, I have had x-ray plates taken of several patients with bilateral Dupuytren's contraction and in none of them have cervical ribs been found.

Probably no one of these factors holds for all cases. Quite often it would seem that long-continued slight trauma has a definite influence, although in many reported instances trauma can apparently be definitely excluded, and other causes must be sought. As a matter of fact, it must be acknowledged that often the etiology, in a given case, is quite obscure.

TREATMENT

In all operative procedures for the relief of Dupuytren's contraction the hands should be thoroughly prepared by one of the methods prev-

ously described, and asepsis should be preserved until the healing is complete. An Esmarch bandage is advisable in order to have a bloodless field for operation. Absolute hemostasis is essential. General anesthesia is usually necessary, but on several occasions I have done extensive excisions of the palmar fascia after blocking the nerves at the wrist with a 1 per cent solution of novocain. In very advanced cases of long standing amputation of the little and ring fingers may be necessary. Splints and apparatus for continuous extension may possibly be of some slight use if applied systematically very early in the course of the disease, but these are absolutely without value later, and should only be used in the post-operative treatment. As a general rule, after operation the fingers should be extended on a splint systematically for at least three weeks, and then at night for several months.

Dupuytren's Operation.—A transverse incision about 2.5 cm. (1 inch) long is made opposite the metacarpophalangeal articulation, dividing the skin and the thickened fascia. Care must be taken not to injure the flexor tendons. If the finger cannot be extended after this incision, another may be made opposite the articulation of the first and second phalanges, and if these are not sufficient as many transverse incisions through the skin and fascia as seem necessary, until complete extension is possible. The wounds are dressed with silver foil, boric ointment, or in some other way appropriate to the particular case. The fingers should be extended on a splint which is allowed to remain until the wounds are completely healed, or for about three weeks. After this the splint may be removed in the day time, but should be reapplied and worn at night for several months. Slight massage and passive motion should be begun after two weeks, the manipulations being gradually increased until the voluntary motions are normal.

Adams' Operation.—A fine tenotome is inserted between the skin and the fascia bands at points where the skin is not closely adherent to the fascia. The knife is turned and the fascia bands are divided from without inward by a sawing motion. Care must be taken not to injure the flexor tendons. These divisions may be made in as many places as necessary to loosen the finger freely, and to allow full extension. Sometimes as many as ten or twelve divisions may be necessary. Any selected dressing may be applied and the fingers then extended on a splint. The subsequent treatment should be much the same as that following Dupuytren's operation.

These two operations are the simplest, and sometimes are per-

niantly successful, but in my opinion this success is largely due to a vigorous after-treatment. If this is omitted recurrence is likely. In some instances, when the physical condition contraindicates more extensive procedures, one or the other of these operations should be done.

Multiple Transverse Division of the Fascia Through an Open Longitudinal Incision.—This procedure is advised by Hardie, Kocher, Keetley, and others.

A longitudinal incision is made over the contracted band, and the skin is separated from the fascia as completely as possible. The fascia band is divided transversely as many times as may be required. The skin is closed with horse-hair, and the wound dressed aseptically.

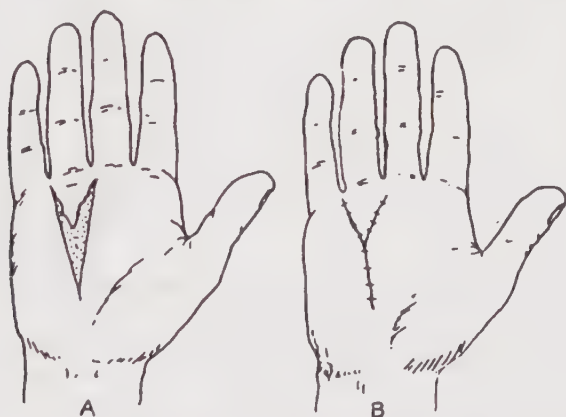


FIG. 800.—Operation for Dupuytren's contraction.—The V-shaped incision with subsequent closure. It is seldom, except in the earliest cases, that the skin can be closed in this manner. If the contraction is of long standing and the skin is much involved, large portion of the defect cannot be closed by suture, and skin grafting is necessary.

The fingers are extended on a splint which should be worn for three weeks. Massage, passive motion and a splint, at night only, for several months constitute the subsequent treatment.

Recontracture may occur later, but this is a better procedure than either Dupuytren's or Adams' operation.

Excision of the Contracted Fascia.—It is impracticable to excise the palmar fascia completely, but large areas may be removed without difficulty. Operations based on this principle are certainly rational and give the best ultimate results. Excision of the thickened fascia through a longitudinal incision gives better results than a simple division of the band in several places through a similar incision. The fascia may be taken out through a V-shaped incision, the apex of

which is about the level of the transverse palmar crease, with the base a little above the root of the affected finger. The incision is carried down through the fascia, and the flap of skin and fascia is lowered. After the finger (or fingers) has been straightened, the contracted fascia is removed, and the skin is closed if possible. This is not often practicable, as the puckering of the skin and its infiltrated condition prevent satisfactory closure. If defects are left, they may be grafted.

In some instances the involvement of the skin is so marked that it is useless to attempt suturing, and in these cases I have found it better to excise the skin completely, and either graft with a whole-thickness graft, or to apply a pedunculated flap from the abdomen. Where the

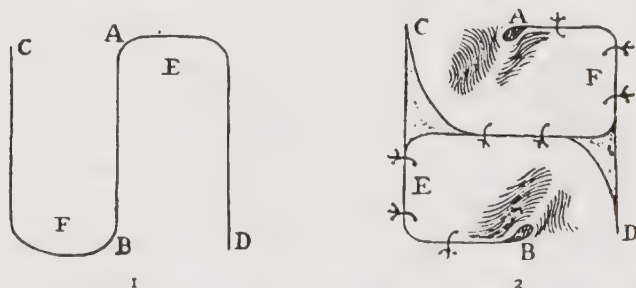


FIG. 801.—Griffith's operation for Dupuytren's contraction (*Binnie*).—1. The contracted palmar fascia is excised through the incision AB. Then the flaps E and F are made by the curved incisions AD and BC and are raised. 2. The free end of the flap E is turned so that it covers the raw surface left by the reflexion of the end of the flap F, and the end of the flap F covers the raw surface left by the reflection of the flap E.

skin is much involved operations utilizing flaps from the palm cannot be successfully carried out.

It may be advisable to do a combination operation in stages. For instance, we can make a division of the fascia by one of the methods previously described, which will allow extension, and follow this after healing is complete with a more radical procedure. A modification of **Griffith's** operation may be of use in selected cases as follows: Reflect the flaps as described in the diagram at once and excise the fascia, instead of trying to excise it through the longitudinal incision AB, as advised by Griffith. Then shift the flaps as shown in the diagram. This method is contraindicated in cases in which the skin is thin and much involved (Fig. 801).

Lotheissen's Operation.—A curved incision is made extending from the middle of the ulnar side of the first phalanx of the little finger down to the ulnar side of the palm and across just above the wrist to the base of the thenar eminence. The flap is reflected, the

fascia is excised and, after the fingers have been extended, the flap is sutured in position. There is always a defect left near the wrist, which may be allowed to granulate, or may be grafted (Fig. 802).

Hutchinson, in 1917, advocated a new method. He excises the thickened palmar fascia with the digital prolongation and closes the skin. He then turns the hand over and makes a semi-lunar incision over the first interphalangeal joint, divides the extensor tendon and slightly shortens it. After removing the head of the first phalanx he sutures the tendon and closes the skin wound. No splint is used, but he begins gentle active and passive motion within a few days.

This operation might be indicated in extreme cases in which there was shortening of the anterior and lateral ligaments, but it seems unnecessary to shorten the finger when an equally good result can be obtained by dividing the ligaments after proper excision of the thickened fascia. The shortening of the extensor tendon is unnecessary, as this will soon regain its original length after the finger has been extended for a little time.

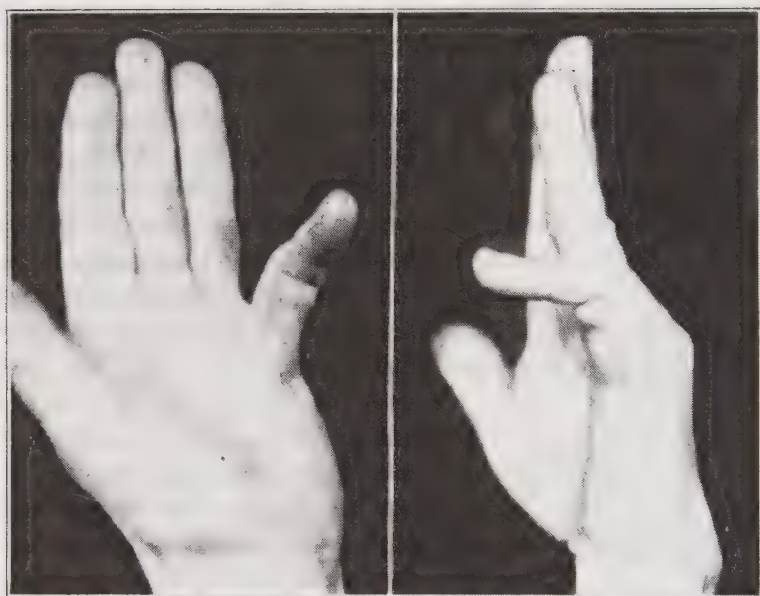


FIG. 802.—Lotheisen's operation for Dupuytren's contraction. (*Binnie*).—The curved incision *ABC* is made, the skin is reflected, and the thickened palmar fascia is excised. The fingers are extended and the edges are closed as far as possible. The raw area which is usually left may be grafted.

In my own work I have found that the best permanent results are always obtained when the thickened contracted fascia is excised. The approach varies with the extent of the contracture. The condition of the skin involvement with scar tissue should determine to what extent it should be utilized in closing the defect. Unless there is a reasonable chance of success it should be excised, and the defect covered

with a graft of whole-thickness skin, or with a pedunculated flap of skin and subcutaneous fat, from a distant part. The latter method eliminates any pain which might occur following the removal of the protection afforded the underlying parts by the palmar fascia.

FIBROLYSIN has been used in the treatment of Dupuytren's contraction and good results have been reported, especially after its use in conjunction with multiple transverse incisions through the contracted bands. My belief is that the good results were due in large part to the operation, and the prolonged post-operative massage and splinting. That the fibrolysin has not much effect is suggested by the



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FIG. 803.—Dupuytren's contraction of the little finger.—1 and 2. Front and side views. This contraction was cured by the complete excision of the thickened palmar fascia and closure of the skin, after blocking the nerves in the wrist. There has been no tendency to recurrence. The little finger of the other hand had also been successfully operated upon by another surgeon several years previously.



FIG. 804.—Bilateral Dupuytren's contraction involving the right ring finger and the left middle finger.—Note the lumpy contracted skin and the prominent bands of tightly drawn fascia. Much against my judgment I was forced to treat this patient by multiple subcutaneous division of the contracting bands, as it was not possible for him to enter the hospital. He obtained temporary relief.

fact that equally good results may be obtained from the operative procedure alone.

The Transplantation of Fingers and Toes to Replace Fingers

Recently Joyce replaced a missing thumb by transplanting the ring finger from the other hand, and obtained a remarkably good functional result.

His method is as follows: "(1) An incision is made along the radial border of the hand beginning at a point which corresponds with the horizontal level of the center of the web between the index finger and the thumb of the sound hand, and somewhat nearer the dorsum than the palm. When the wrist is reached, the incision is carried along the radial border of the forearm for a distance of 2.75 to 5. cm. (1 $\frac{1}{2}$ to 2 inches). The incision on the side of the hand is deepened sufficiently to accommodate the new metacarpal bone, care being taken not to cut across muscle fibers. (In the patient on whom the operation was performed, a plane of fibrous tissue was found apparently filling up the space left by removal of the metacarpal bone, and in this the bone was made.) The articular surface of the trapezium is exposed. The skin and superficial and deep fascia on either side of the incision along the radial border of the wrist are reflected, the tendons of the extensor secundus internodii pollicis, primi internodii pollicis, ossis metacarpi pollicis, flexor longus pollicis, and flexor carpi radialis are defined and one of the dorsal cutaneous branches of the radial nerve is found and divided.

(2) An inverted V-shaped incision is made on the radial side of the ring finger, the apex of the incision being placed midway between the dorsal and palmar aspects of the finger at the level of the proximal interphalangeal joint. The triangular piece of skin marked out by the incision is then reflected upward. The limbs of the incision are carried obliquely backward and forward on to the dorsum and palm of the hand, and are deepened in order to expose the extensor and flexor tendons. These are divided at the extremity of the incisions and the proximal ends prevented from retracting by suturing them to the periosteum and soft tissues covering the metacarpal bone. The soft tissues are now divided at the base of the proximal phalanx on its radial side down to the periosteum. The digital vessels on this side of the finger are tied and the distal end of the collateral branch of the median nerve is sought for and identified. The extensor and flexor tendon

are dissected up in a distal direction exposing the base of the proximal phalanx, and a hole is drilled through the base of the bone and threaded with a stout catgut suture. The finger is now dislocated from the metacarpal bone by cutting through the ligaments of the metacarpophalangeal joint. The soft tissues on the ulnar side of the proximal phalanx are raised for a short distance from the periosteum, the operator



FIG. 805.

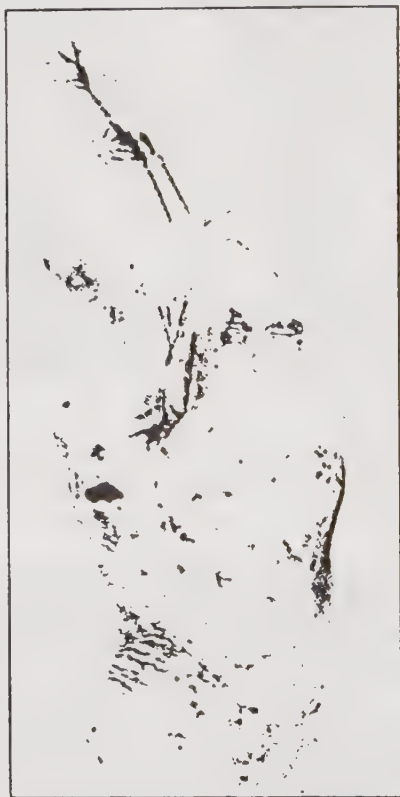


FIG. 806.

The substitution of the ring finger of the left hand for a missing right thumb (*Joyce's case*).

FIG. 805.—The right hand before operation.

FIG. 806.—The two hands grown together, after removal of the plaster.

working from the deep aspect and taking care not to injure the digital vessels.

The triangular flap of skin is now turned down to cover the head of the metacarpal bone, and the incisions on the dorsum and palm of the hand are sutured with fine catgut stitches. The proximal end of the extensor tendon is pulled over to the palmar aspect of the hand, and the ring finger is then ready for grafting into its new position.

(3) The two hands are apposed in a manner which is sufficiently indicated in the accompanying photographs. This stage of the operation is now completed as follows:

(a) The flexor tendons of the finger are joined to the long flexor of the thumb, if this has been found, or to the flexor carpi radialis if more convenient.

(b) The proximal phalanx is anchored in its position by stitching the catgut suture, threaded through its base, to the scar tissue covering the articular surface of the trapezium (Figs. 805-809).

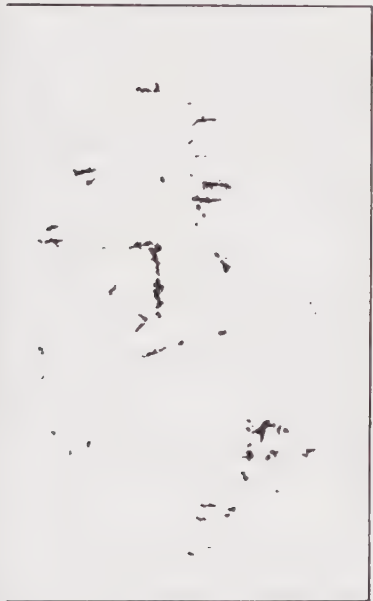


FIG. 807.



FIG. 808.

FIGS. 807 and 808.—(*Joyce's case continued.*)—The transplanted ring finger in its new position

(c) The extensor ossis metacarpi pollicis is stitched to the periosteum at the base of the proximal phalanx (new metacarpal bone).

(d) The tendons of the extensores secundi and primi internodii pollicis are united and joined to the extensor tendon of the finger (new thumb).

(e) The radial cutaneous nerve exposed in the first stage of the operation is sutured to the collateral branch of the median nerve of the ring finger.

(f) The skin incisions are sutured. The incision on the radial border of the wrist is sutured in a distal direction to cover the base the new metacarpal bone and the tendon unions. The dorsal and

palmar edges of the incision on the radial border of the hand are sutured to the dorsal and palmar edges of the skin bordering the triangular raw area on the radial border of the ring finger (new thumb). Fine interrupted catgut sutures are used throughout for the skin stitches.

The hands are then fixed in the apposed position with plaster of Paris, which is left undisturbed for four weeks, and is then removed.

(4) The final stage in the operation consists in dividing the nutritive flap (two months later) and separation of the hands, ligature of the



FIG. 809.—(*Joyce's case, continued.*)—X-ray after transplantation.

proximal ends of the ulnar digital vessels of the finger which has been removed, and closure of the raw areas which remain."

I have not yet had an opportunity to try this method, but it is undoubtedly rational, and ought to be a satisfactory procedure.

Toes have been transplanted (Nicolodini, Krause, Klemm, Eiselsberg, Hörhammer and others) to take the place of a missing thumb or finger, but the result is seldom worth the trouble.

The bone of a lost phalanx may be replaced by a shaped piece of rib cartilage (Morestin, Soubeyran and Perret), or by a phalanx from

the toe (Wolf, Goebel and others), or by a free bone graft from the tibia or ribs (Morestin and others).

TENDON INVOLVEMENT

If tendons of either extremity are involved in addition to the skin and are tightly adherent to the scar and underlying tissue, they should be carefully freed, and the fat of the flap placed in such a way that it may act as a sort of channel for them. Passive motion should then be begun after ten days.

If a portion of a tendon (or tendons) is destroyed the scar connecting the ends may be utilized to form the new tendon; the tendon may be lengthened by the desired plastic; a new tendon may be made of a fascia tube; a free tendon transplant may be used, or a silk tendon may be made. In the majority of these cases the flap should be

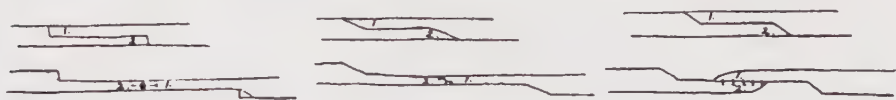


FIG. 810.—Simple methods of tendon lengthening. The more complicated methods give an uneven surface which does not slide so easily, and which makes the return of function slower and more difficult.

securely grown into its position, and then the newly formed tendon should be inserted in a tunnel made in the fat.

In old cases the flexor tendons have sometimes contracted, and lengthening is necessary. The simpler and smoother methods of division and suture are advisable, because function will be more quickly restored. I prefer the use of the fat from the flap for the tendon channel to that of free fat transplants.

Exposed Tendon

At times we are confronted with a wound on the forearm or hand or on the ankle or dorsum of the foot, in which a portion of one or more tendons is exposed, the sheaths having been destroyed. These wounds are usually due to the pressure of a plaster cast or to some injury which has caused destruction of the overlying soft parts, and left the exposed tendon surrounded by a more or less extensive zone of scar tissue. The exposed tendon may become partially or completely necrotic and in due time will slough. These wounds are very sluggish and are

difficult to treat successfully. They are usually infected and must first be sterilized with Dakin's solution, or by some other method which will give a negative bacterial count. The part should be immobilized and all portions of the tendon that are unquestionably necrotic should be removed. If granulation tissue does not soon show a tendency to cover the exposed tendon, several longitudinal incisions should be made in it down to healthy tissue. Usually granulations will soon appear in the slits and, after the removal of any necrotic tendon strands that may appear between them, will soon cover the tendon. A pocket may form at either extremity of the wound, and if this occurs the overlying tissues should be removed and the tendon treated as described above, or excised, as seems best.

There is no reason whatever why the entire thickness of the tendon should not be excised when it is necrotic. Provided that the wound is sterile the tendon defect may be immediately filled by a tendon plastic; or the ends may be secured and the tendon plastic done later if necessary, after the wound has healed.

Occasionally in narrow wounds with normal surrounding skin the edges may be drawn together over the tendon after undercutting, with or without relaxation incisions. If this cannot be done, I have found that the best method of obtaining a resistant painless closure is to use a pedunculated flap from the neighboring skin or from a distant part. The granulating surface may be grafted with small deep grafts which are more likely to take on a poor base than the other types. If the result is not stable and the scar is adherent and resists loosening, it should be excised and the gap filled with a pedunculated flap.

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CHAPTER XXV

SURGERY OF THE LOWER EXTREMITY

THIGH

Loss of Substance.—In the early treatment of extensive superficial wounds or burns involving the crotch and adjacent tissues it is most important that the thigh be held in abduction. Destruction of the skin may be due to operation, trauma, ulceration (chancroidal, tubercular or syphilitic), and burns of various sorts. If the wound is fresh, it should be immediately grafted. Healthy sterile granulating wounds should also be grafted.

When the granulating surface is surrounded by an old tightly drawn scar, or the ulcer is very sluggish, the area must be completely excised with a wide margin down to healthy tissue. The tension of the scar must also be relieved by properly placed incisions, or partial excision, and the raw surfaces immediately grafted. This holds for the entire lower extremity. In this way I have been able to close permanently ulcers which have existed for years.

When the thigh or leg is completely covered with scar, ulceration is common and is difficult to heal. Excision, followed by grafting or the use of a pedunculated flap, offers the only method of permanent cure. In those instances in which the healing is unassisted, a break-down can be confidently looked for in the course of time.

Pedunculated flaps from the neighboring skin may be used, if normal skin is available, and I have employed flaps from the other leg or thigh in these cases. By double transfer a flap from the abdominal wall may be implanted into the wrist or forearm, and then, after flexion of the thigh, the pedicle may be cut from the abdomen and this flap may be transferred to it.

KNEE

Loss of substance around the knee-joint must be covered with flexible strong skin if unimpaired function is to be obtained. If the defect is over the anterior surface, the part should be put up

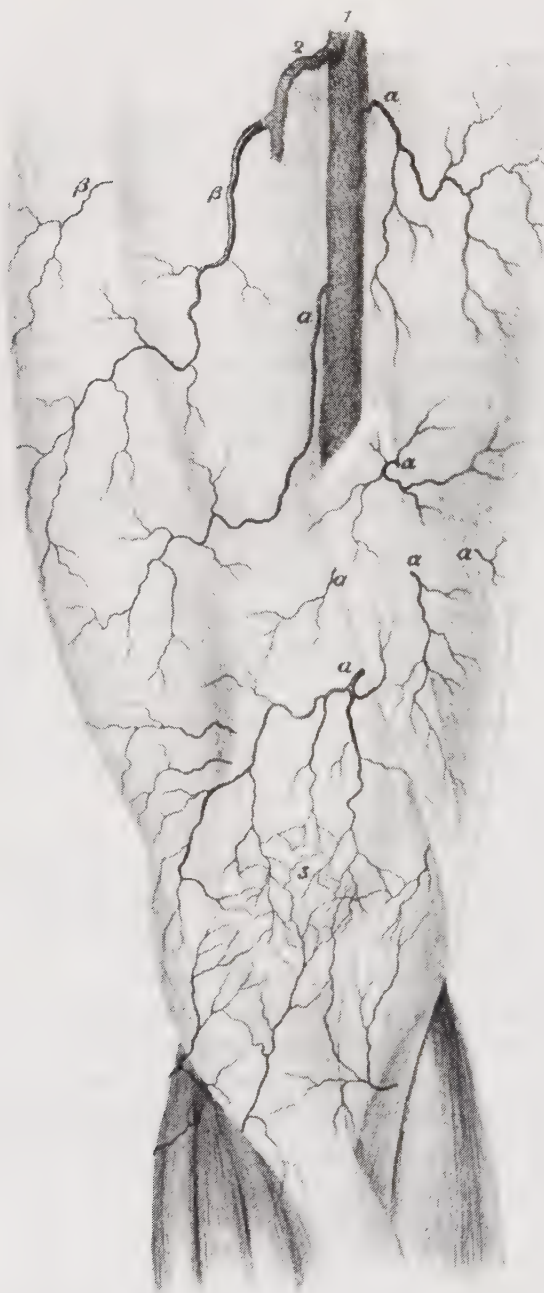


FIG. 811.—Arteries of the skin of the anterior portion of the thigh (*Manchot*).—1. Femoral artery. α. Cutaneous branches of the femoral artery. 2. Profunda femoris artery. β. Cutaneous branches of the profunda femoris. 3. Superficial arterial anastomosis around the knee.



FIG. 812. Arteries of the skin of the thigh, anterior surface of the thigh (*Man*). 1. Cutaneous branches of the gluteal artery. 2. Cutaneous branches of the circumflex iliac artery. 3. Cutaneous branches of the internal pudic artery. 4. Cutaneous branches of the lateral femoral artery. 5. Cutaneous branches of the ileo-lumbar and the last lumbar arteries. 6. Cutaneous branches of the obturator artery. 7. Cutaneous branches of the internal femoral artery. 8. Cutaneous branches of the profunda femoris artery. 9. Cutaneous branches of the popliteal artery. 10. Cutaneous branches of the external femoral artery.



FIG. 813.—Arteries of the skin of the popliteal space and posterior surface of the leg (*Manchot*).—1. Superficial median sural branches of the popliteal artery. 2. Superficial lateral sural branches. 3. Superficial median branches. 4. Musculo-cutaneous branches of the deep peroneal arteries.



FIG. 814.—Arteries of the side of the leg (*Manchol*).—Cutaneous branches of the posterior tibial artery.

in partial flexion; if it be on the posterior surface, the leg should be extended. I have used whole-thickness grafts around the knee with success, but have had the best results with pedunculated flaps. These flaps may be obtained from the same thigh or leg, or from the

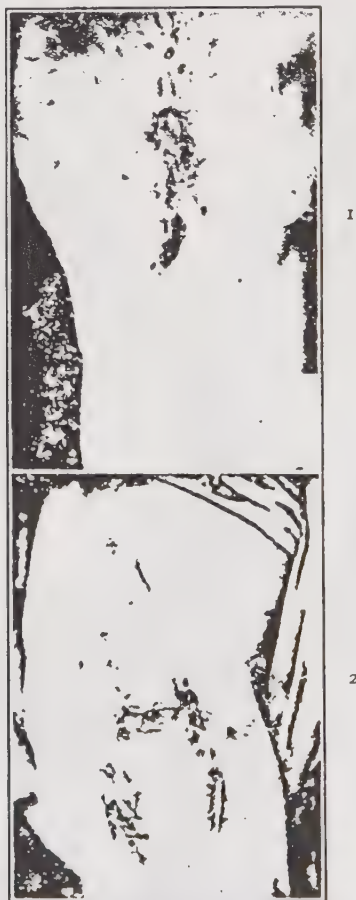


FIG. 815.—Chronic ulcer, three years duration, in an extensive tightly drawn scar of the thigh.—1. This area had never healed and was extremely painful. The entire ulcer with a wide margin was excised down to normal tissue and was immediately covered with Ollier-Thiersch grafts. 2. The size of the healed area can be seen. There has been no recurrence during the three years since operation, and function is much improved.

opposite thigh or leg (Maas and others), according to the situation and extent of the defect.

LEG

Loss of Substance.—Skin grafts, preferably of the small, deep, or whole-thickness variety, may be used to cover defects of any kind



FIG. 816.—Method of gradual stretching of normal tissues. (Morestin).—1. The thigh after the excision of all defective tissues. Note the sutures in position. 2. The thigh is flexed on the body after the sutures are tied. 3. The result of gradual stretching.



FIG. 817.

FIG. 817.—Method of utilizing a bridge flap from the chest wall for covering a poplitea defect (*Hacker*).—This method could only be used in young children and even then its advisability is doubtful.

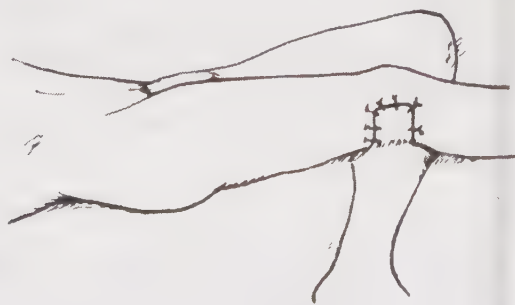


FIG. 818.

FIG. 818.—Method of restoring the popliteal space by means of a pedunculated flap from the opposite leg.

on the leg. Pedunculated flaps may also be employed, and give the best results, especially in exposed positions. Flap may be obtained from the inner or outer portion of the same thigh, depending on the

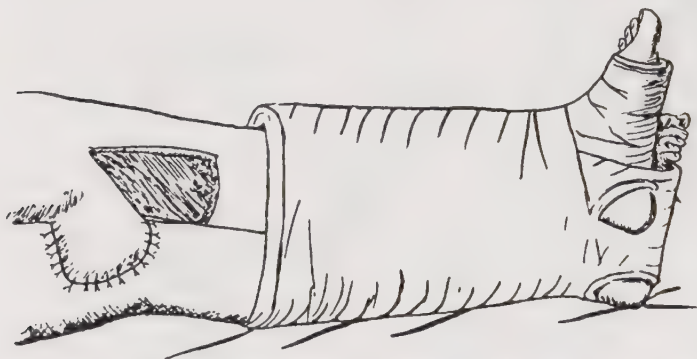


FIG. 819.—Method of covering the anterior surface of the knee with a flap from the other leg (*Maas*).—Note the position of the legs in the cast.

position of the ulcer, and may be sutured over the defect after flexion of the leg on the thigh; from the opposite thigh for the inner lower third of the leg, the ankle resting across the opposite knee; from the opposite leg for the inner lower third, the ulcerated leg being crossed



FIG. 820.



FIG. 821.

Method of utilizing pedunculated flaps from the opposite leg for covering defects.

FIG. 820.—A flap from the under surface of the opposite leg to cover the knee (*Maas*).

FIG. 821.—A flap from the inner side of the opposite leg to cover a defect on the middle third of the back of the leg.

diagonally over the other leg; from the opposite leg for the outer lower third, the normal leg being crossed over the ulcerated limb. All of these positions may be varied to suit existing conditions.

ANKLE

Loss of Substance.—The foot slightly inverted should be put up at right angles to the leg for all losses of substance in this region. Wounds or ulcers around the ankle and over the malleoli are difficult to heal. If skin grafting seems inadvisable, a pedunculated flap should be used from the same leg or from the selected portion of the other leg, if the wound is of any size. In cases of small losses of substance the surrounding skin, if normal, may be undercut, and the tissues drawn in and sutured. If relaxation incisions are necessary the resulting defects may be grafted.



FIG. 822.—Contracture of the knee following an extensive burn. Duration two years 1. Note the extensive destruction of tissue and the areas on the thigh which had been grafted. Also the mass of scar tissue filling the popliteal space and preventing extension. 2 and 3 Result of the reconstruction of the popliteal space by shifting in available flaps, and skin grafting the remaining areas. Photograph taken six months after operation.

FOOT

Loss of Substance.—Wounds on the foot require active assistance in healing if the best functional results are to be obtained. On the dorsum, skin grafting is usually sufficient except over the instep, where the result may not be stable unless a whole-thickness graft is employed. In this situation a pedunculated flap from adjacent skin, or from the other leg, may be necessary. On the sole, we frequently have deep destruction of soft parts, and this is especially serious when it involves the covering of the heel and other weight-bearing portions. In these situations skin grafting is a waste of time, the only satisfactory result being obtained by the use of a thick pad of skin and fat from the other leg.

Contractures. Thigh and Leg.—We find at times, following burns, all degrees of contracture of the joints of the lower extremity. The thigh may be completely flexed on the abdomen and held immovable by a vast mass of scar tissue; the leg may be flexed on the thigh, the foot, on the leg, etc. All gradations may be found between this extreme grade and that of slight limitation of motion.



FIG. 823.—Extensive third degree burns of both legs and feet, and the left thigh.—First seen six months after the accident. Note the exuberant granulations. Also the flexion of the left knee and ankle due to scar tissue contraction, and the right knee due to posture. The extent of spontaneous healing from the edges can be seen, especially on the right leg and ankle. The legs and ankle were straightened and the wounds were much improved by grafting. Unfortunately the child died from acute uremic poisoning.

Treatment. The ideal method of treatment in all situations is the complete excision of the contracting scar, but in many cases, on account of its extent, this is impossible. In these instances division down to normal tissue and relief of the faulty position, with immediate grafting,

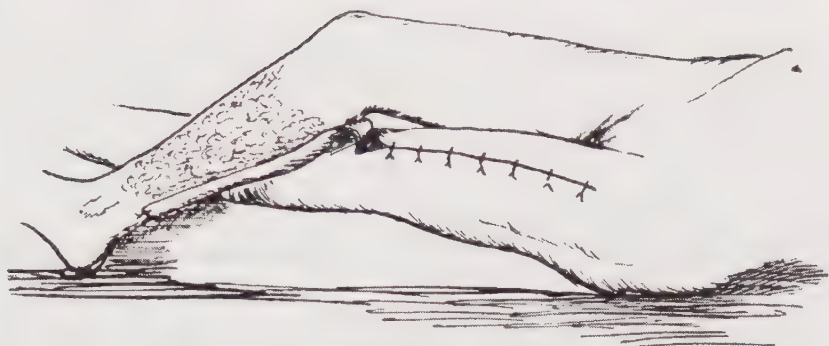


FIG. 824. Delbet's method of utilizing a flap from the opposite thigh to form a band of elastic skin in a burn involving the whole circumference of the leg.—The rest of the granulating surface is gauzed. The flap as illustrated is so long that a large portion would slough unless the circulation was assured by one of the methods described in the text.

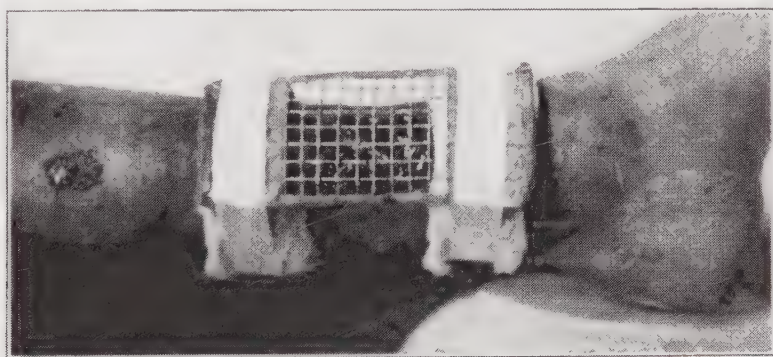


FIG. 825. The use of a wire cage in the treatment of an ulcer of the leg.—Note the thick felt padding and the method of securing. The cage may be used when exposure to the air is desired, or for purpose of protection.

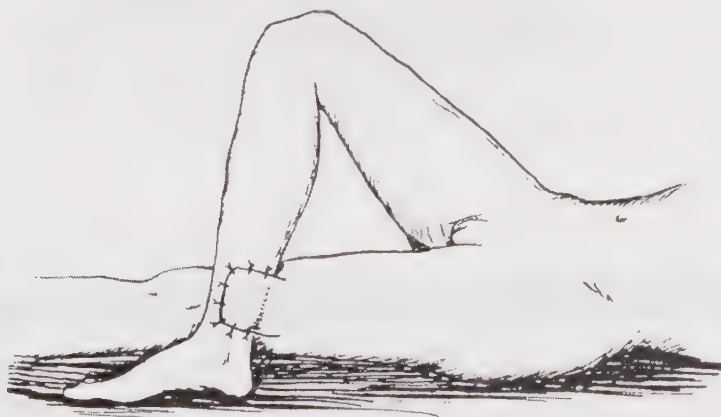


FIG. 826.—Position assumed when covering a loss of tissue on the inner lower third of the leg by a flap from the opposite thigh.

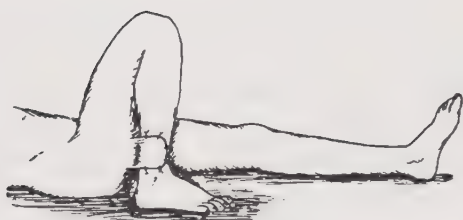


FIG. 827.



FIG. 828.

FIGS. 827 and 828.—Position assumed in obtaining flaps from the same thigh to cover defects on the leg.—This is a very irksome position and should only be used in exceptional cases.



FIG. 829.



FIG. 830.

FIGS. 829 and 830.—Position assumed in obtaining flaps from the opposite leg for covering defects on the inner and outer surfaces of the lower third of the leg.



FIG. 831.—Method of closing a deep cavity in the lower end of the tibia following osteomyelitis.—(I operated on this case at the Rockefeller War Demonstration Hospital at the request of Major G. A. Stewart, U. S. A.) The defect was the full depth of the marrow cavity, and was somewhat undermined below. The surrounding skin was infiltrated with scar tissue. On account of the age of the patient (over sixty years) I did not feel justified in using a pedunculated flap from the other leg, so it was determined to try a pedunculated flap from adjacent tissue in spite of its infiltration with scar.

or the interposition of a pedunculated flap, is indicated. It is sometimes impossible to obtain pedunculated flaps from the same thigh, the opposite thigh, or leg, on account of scar tissue covering all of these areas, and if a pedunculated flap is indicated in such cases it has to be obtained by a double transfer.

Some of the most vicious contractures with which we have to deal are found around the knee-joint. These vary from complete obliteration of the popliteal space, with fusion of that portion of the leg and

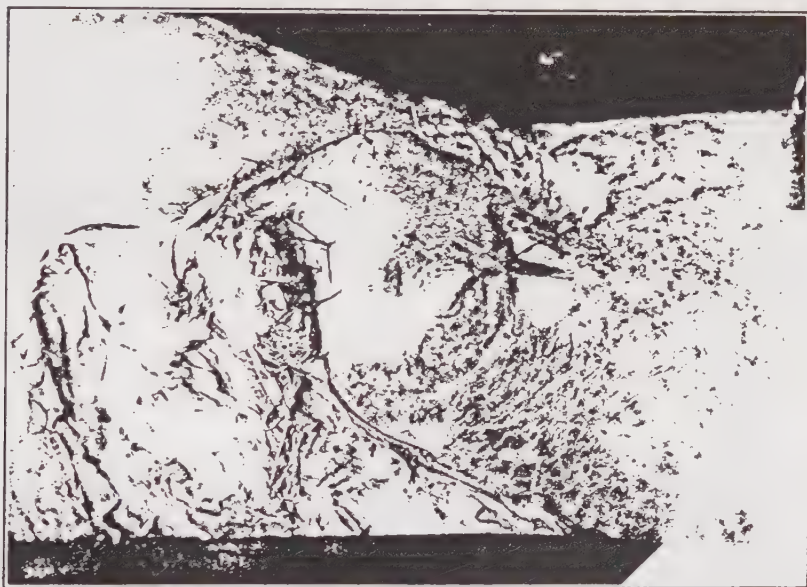


FIG. 832.—Method of closing a bone cavity, *continued*.—The wound had been prepared with Dakin's solution and was sterile. The flap from below and behind the defect (with its pedicle above and posterior), was raised and turned into the defect. It was so rigid on account of scar tissue that it could not be fitted down into the cavity. This difficulty was overcome by filling the cavity with a free fat graft from the thigh, and the flap was sutured over this. The defect from which the flap was raised was grafted with Ollier-Thiersch grafts. The photograph shows the flap held with horsehair sutures and the grafts in position.

thigh, to much less severe contractures with differing amounts of loss of function.

In old cases of contractures in flexion, tenotomy or lengthening of the hamstring tendons may be necessary. After relief of the contracture the leg should be extended slowly in order to stretch gradually the arteries and nerves. The defect should then be filled with a pedunculated flap, as described under loss of substance for this region.

Morestin's method of excising a granulating wound or contracture



FIG. 833.—Method of closing a bone cavity, *continued*.—The flap has lived and fills the defect. A portion of the fat graft broke down. The Ollier-Thiersch grafts were also successful. The result was relief of a long standing defect, and shows that much can be accomplished with a scar infiltrated flap. The procedure would have been quite a usual one if the surrounding skin had been normal.

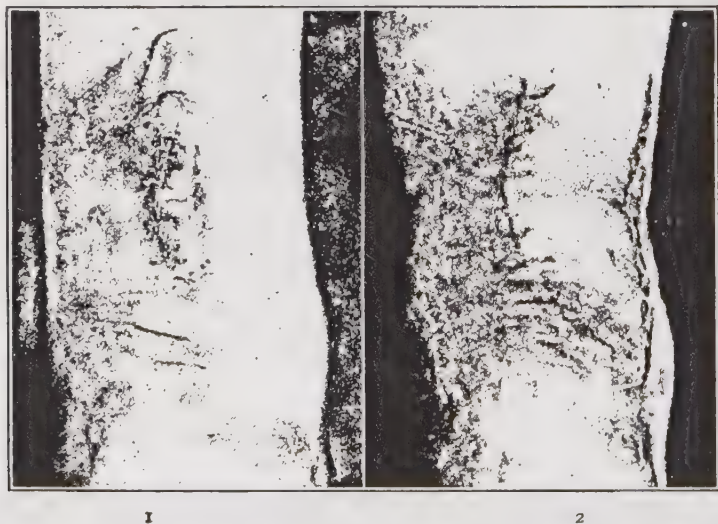


FIG. 834.—Painful, unstable adherent scar over the tendo Achillis.—1. Note the puckering of the skin due to deep adhesions over the upper portion of the scar. The scar was completely excised. A relaxation incision was made just behind the external malleolus, and the skin and fat were loosened and shifted backward. This made closure without tension possible. The defect left by the spreading of the relaxation incision was immediately grafted. 2. Note the healing over the tendo Achillis, and the healed relaxation defect after one month has elapsed.



FIG. 835.—Contracture of the foot following a burn. Duration eighteen months.—1. Note the flexion of the foot at the ankle, and the eversion of the sole of the foot. 2. The result of a plastic operation with Older-Thiersch grafting of the remaining defect.



FIG. 836.—Contracture of the foot with marked distortion of the toes due to a burn. Duration seven years.—1 and 2. Note the position of the toes. The foot walks on the heel. The arrow indicates the position of the toes. 3. Result of plastic operation with grafting of the toes and grafting the denuded surfaces. The foot now runs on the toes more plainly, but still not so much as a normal foot in respect to walking, or running.

in the groin or popliteal space, and suturing the normal skin edges with subsequent gradual stretching of the skin, may be used in selected cases.



FIG. 837.

FIG. 837.—Method of restoring a portion of the sole of the foot by means of a pedunculated flap from the other leg (*Ombredanne*).—Note the posture.



FIG. 838.

FIG. 838.—Method of covering a heel defect with a flap from the other leg (*Maas*).



I

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FIG. 839.—Painful scar of heel following destruction of the soft parts in an accident. Duration three years.—1. The scar involving the heel and inner side of the foot below the malleolus. The patient was unable to bear her weight on the heel on account of the pain. 2. The scar over the heel was excised and a pedunculated flap from the other leg was implanted. Note the position of the parts in the plaster cast.

I have seen a number of instances of complete scarring of the leg in which only limited flexion was possible on account of the tightly

drawn scar over the anterior portion of the joint. This can be corrected by dividing the scar and implanting a whole-thickness graft or a pedunculated flap.



FIG. 840.—Painful scar of the heel, *continued*.—1. The flap in position immediately before cutting the pedicle, twelve days after operation. Note the pedicle of the flap on the leg beneath, and its insertion into the heel defect. 2. Patient standing on the heel three months after operation. Note the soft pad under the heel.

Ankle and Foot.—We often see contractures of the foot and ankle following extensive denudations or burns. If flexion is complete, the dorsum of the foot being bound to the ankle, we must relieve the contracture and fill the defect with a graft, or with a pedunculated flap,

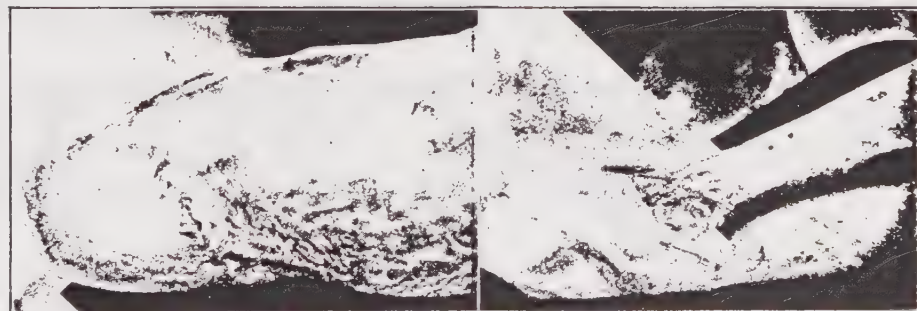


FIG. 841.—Painful scar of heel, *continued*.—1. Taken two and a half years after operation. 2. The position assumed during the transfer of the flap. Note the flap and the defect from which it was taken. This result is particularly satisfactory as it has allowed the patient to resume her occupation, and to walk without pain.

the foot in the meantime being placed in a position of slight extension. If the contracture is in extension, the scar must be divided and in many instances the tendo Achillis lengthened. The foot is then placed in a slightly flexed position, and the defect filled with a graft or a pedunculated flap from the neighborhood, or from the other leg.

In those cases in which there is permanent flexion or extension of the toes due to scar tissue the contracture should be relieved, and the defect filled with a graft or flap.



FIG. 842.—Method of constructing the sole of a foot by the use of pedunculated flaps from the other leg.—1. The sole of the left foot is covered with a thin painful scar which is immediately over the bones and ligaments. The patient has been unable to bear her weight on the foot since the accident, four years previously. Compare the defective foot with the normal one. The only method which promised the slightest chance of success was the implantation of pedunculated flaps of fat and skin from the other leg. The sole could not be covered with a single flap. 2. The foot secured to the opposite leg during the implantation of the first (anterior) flap. Note the position which was quite comfortable.

On the sole of the foot we frequently find practically all of the soft tissue destroyed, and the weight-bearing bony prominences covered with a thin tight scar which is constantly ulcerating, so that on account

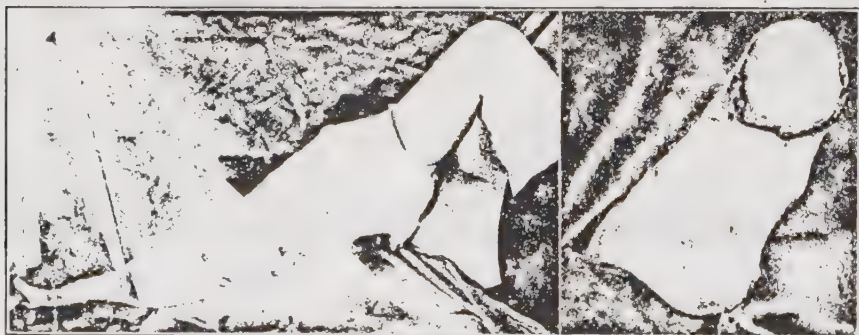


FIG. 843.—Construction of the sole of a foot. *continued*.—1. Position assumed during the implantation of the first flap. 2. The result of the first implantation, one month after operation.

of the lack of protection to the bones it is impossible to bear the weight of the body on the foot. In these cases we must supply a thick pad of skin and fat to cover the sole, and this is best done by using peduncu-



FIG. 844.—Construction of the sole of the foot, *continued*.—1. Position assumed during the implantation of the second flap, six months after the first operation. 2. The result of the second implantation, three weeks after dividing the pedicle and fitting it into position.

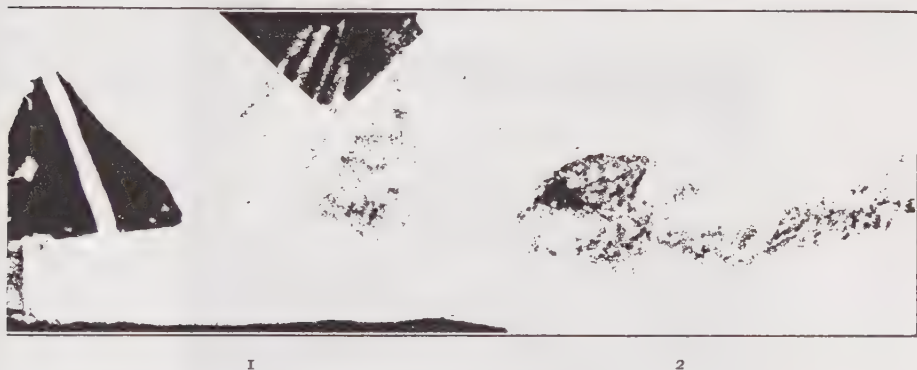


FIG. 845.—Construction of the sole of a foot, *continued*.—1. Third operation, seven months later. Position assumed during the implantation of the flap over the heel. 2. The scars on the opposite leg showing the areas from which the flaps were taken. These areas were grafted. The first flap was taken from the central area; the second from the lower area, and the third from the upper. The result in this case was far better than could have been obtained by an artificial foot, which was the only alternative.



FIG. 846.—Construction of the sole of the foot, *continued*.—The result of the implantations, taken one year after the final operation. The patient has been able to walk about without pain and has a useful foot. The scars between the flaps can be removed and the soft edges of the flaps united, which will improve conditions.

lated flaps from the other leg (Maas, Ombrédanne and others). After removal of the scar, if the circulation of the bone seems poor, it is advisable to chisel off the surface down to the spongy portion, and to apply the flap directly to this area where the circulation is good.

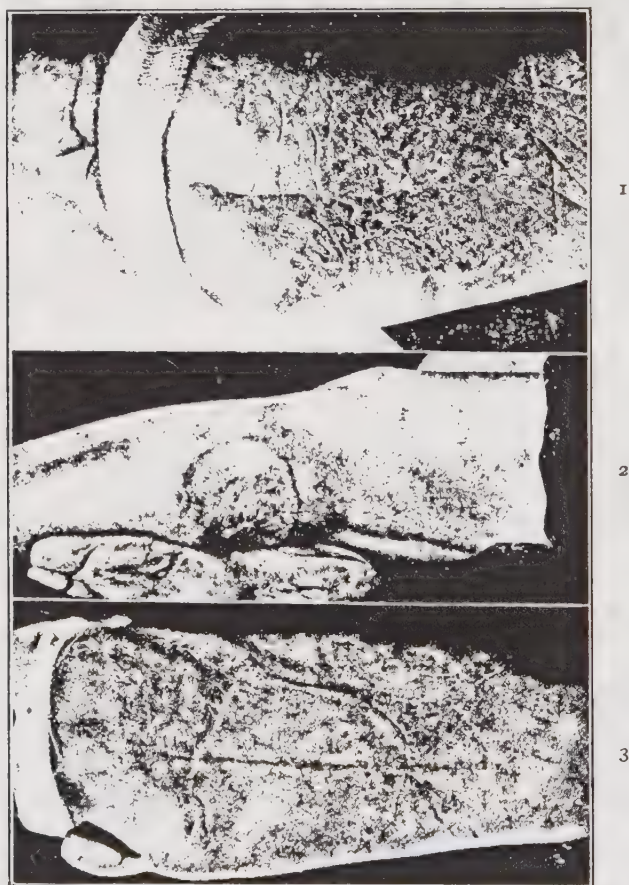


FIG. 847.—X-ray burn of the sole of the foot. Duration one year.—1. The condition of the burnt area. Constant intense pain, and frequent breaking down were the principal causes of complaint. The entire area was excised down to normal tissue. A pedunculated flap from the back of the other leg was implanted. 2. The position assumed to bring the flap into the defect. The pedicle of the flap was close to the foot. Photograph taken twenty months after transplantation of the flap. The area from which the flap was taken had been grafted. Note this area and its relation to the flap. 3. The flap in position twenty months after transplantation. The skin of the flap is normal in appearance. The flap is soft, movable, and is on the level with the surrounding skin. All pain has disappeared and the result is satisfactory.

Sometimes the pad under the heel alone is destroyed, or a portion of the sole. In all of these situations I have been able to supply a thick pad from the other leg, and in this way a useful weight-bearing foot has been made.

Unless a pad can be supplied when the soft tissue of extensive areas of the sole has been destroyed, it is advisable to amputate. An artificial foot will be infinitely more useful than one which causes exquisite pain whenever any weight is placed upon it.

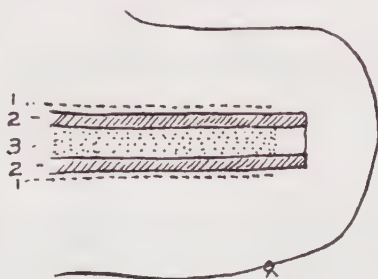


FIG. 848.—Schematic drawing to show the aperiosteal method of treating the bone in amputation stumps.—1. The periosteum. 2. The bone. 3. The marrow. Note that the periosteum and bone marrow are removed from the bone for the same distance, actually about 1. cm. ($\frac{3}{8}$ inch) from the saw line.

AMPUTATIONS

The Aperiosteal Method of Treating the End of the Bone in Amputations.—When amputation has been necessary either as a primary



FIG. 849.—Ulcer on an amputation stump.—In this case there was too much tension on the skin flaps and sloughing occurred. The skin edges might be brought much closer by continuous elastic traction and the area grafted; the area could be excised and the edges approximated, or if conditions indicated the necessity, a pedunculated flap from the other leg or thigh might be used to fill the defect.

procedure or for stump shortening, Lyle and others have emphasized, and my own experience supports their view, that the aperiosteal method of treating the end of the bone is the simplest and in the end

the most satisfactory. The periosteum is removed for a distance of about 1. cm. ($\frac{2}{5}$ inch) above the saw line, and the medullary canal is curetted out for the same distance. This gives a painless stump and prevents the formation of bony spicules.

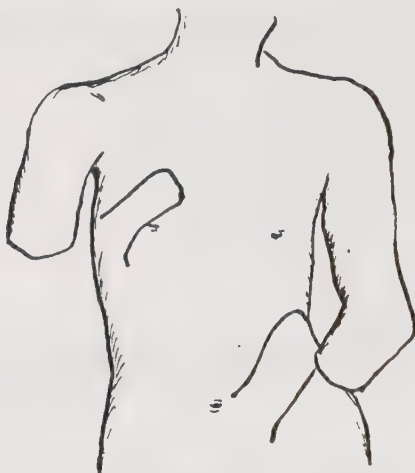


FIG. 850.—The use of pedunculated flaps to cover amputation stumps (*Hans*).—The dark lines indicate the outlines of flaps. Flaps of almost any shape and size may be raised from any desired position with pedicles above or below.

Unhealed Amputation Stumps.—The problem of healing a sluggish wound on an amputation stump, or of covering a poorly protected stump with a pad of skin and fat is often presented.

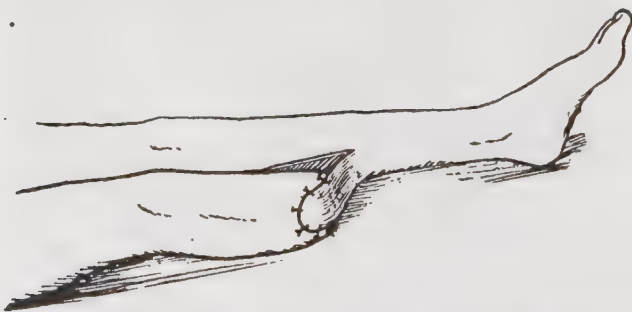


FIG. 851.—Method of covering a defective stump with a flap, pedicle downward, of skin and fat from the other leg.—This same type of flap may be obtained from any desired level and the direction of the pedicle may be varied to suit conditions.

Healing may be hastened by excision of the area and grafting, or better still by means of a pedunculated flap from the abdominal or thoracic walls for the upper extremity, or from the other leg or thigh

if the lower extremity. If the stump is poorly padded, the end after being freshened may be buried in a pocket, or under a bridge flap of skin and the full thickness of the underlying fat in a convenient situa-

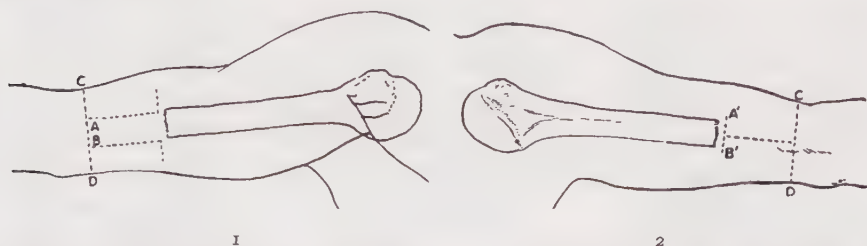


FIG. 852.—Kinematic plastic amputation of the arm (*A. P. C. Ashhurst: Annals of Surgery, December, 1914*).—1. Inner surface of the arm. The flap of skin and subcutaneous fat AB is to cover the end of the bone. A circular amputation is done at CD. 2. Outer surface of the arm. The flap AB is sutured to the line A'B'.

tion, and in due time this mass of tissue may be transferred to the stump, which it covers with a soft resistant pad. A similar method may be used to lengthen the stump by wrapping a cuff of skin and fat around the bone.

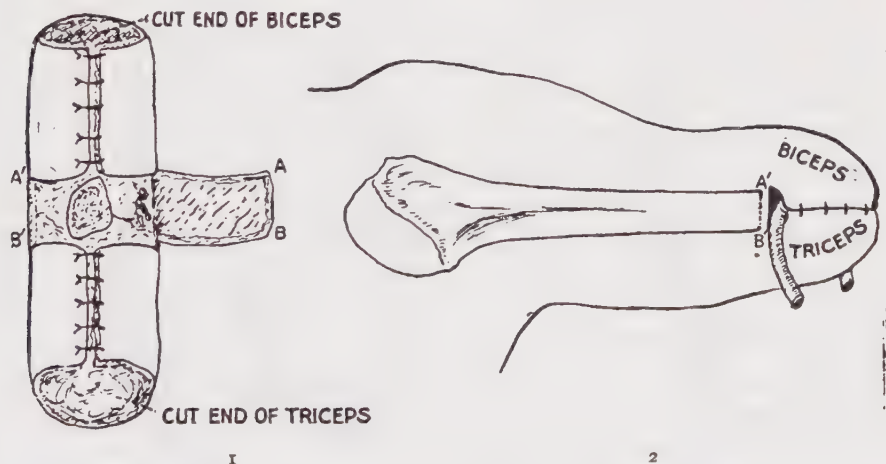


FIG. 853.—Kinematic plastic amputation of the arm (*A. P. C. Ashhurst: Annals of Surgery, December, 1914*).—1. Diagrammatic view of the end of the stump. The flap AB, is sutured to the line A'B'. The skin overlying the muscular flaps is sutured around them as a cylinder. 2. The biceps has been sutured to the triceps, and a rubber tube is passed through the loop before suturing.

KINEMATIC PLASTICS

The possibility of utilizing the muscles of the stump to impart movement to an artificial limb was first advanced by G. Vanghetti (an Italian physician), in 1896. In a series of papers since then he has

again and again advanced his theory, but up to the time of the great war there had probably been only about twenty cases treated along the lines suggested by him. The great number of cases requiring

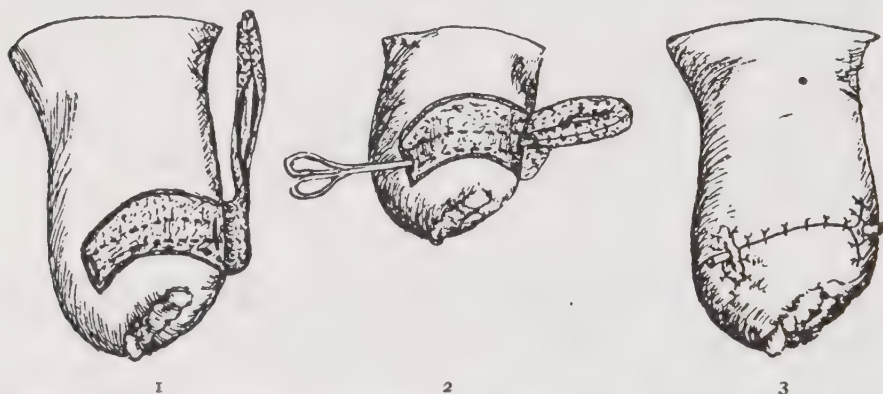


FIG. 854.—Sauerbruch's method of lining the muscle loop with a pedunculated flap of skin (*Gaudiani: Annals of Surgery*, Apr., 1918).—1. Note the situation from which the skin flap is taken and the lines marking the openings of the tunnel through the muscle. 2. The flap made into a tube, skin side inward, and being drawn through the tunnel in the muscle. 3. The skin tube in position and wounds closed.



FIG. 855.

Types of motor flaps.



FIG. 856.

FIG. 855.—Codivilla's knob motor flap for the foot (*Gaudiani: Annals Surgery*, Apr., 1918).

FIG. 856.—Sauerbruch's double motor loop.—The dotted lines indicate the channels through the muscle masses (*Gaudiani: Annals of Surgery*, Apr., 1918).

amputation during the last four years has enabled surgeons to test out and prove the soundness of his ideas.

By kinematic plastics is meant any kind of procedure by which muscular masses can be used to carry voluntary movement to the artificial limb. Every moving portion thus obtained is called a *plastic-motor* (motor flap).

Nearly all forms of motor flaps are of two types, the *loop* and the *knob*; they may be single, double or multiple. The movements may be in one direction only (unimotor), or the motor flap may execute two opposite movements in succession (plurimotor). If the motor flap is on the extremity of the stump it is called *terminal*; if on the continuity of the stump it is called *extraterminal*.

The method may be employed on the upper or lower extremities. Under ideal conditions the motor flaps may be formed at the primary operation. Nevertheless if conditions are not favorable, every particle of viable tissue should be preserved for future use, and the muscles and tendons sutured over the bone end in order to preserve their function. The motor flaps may then be formed later. They must be firm and resistant, and must contain enough functional muscle tissue to carry out the demands placed upon them. The plastic surgeon may be of use to the orthopedist in planning the shapes and in covering and lining these motor flaps with skin, which must be in perfect condition. The skin must have the proper blood and nerve supply, in order that it may withstand the strain which will be put upon it, as the whole procedure will be a waste of time unless the flaps are suitably covered with skin. The artificial limb is usually secured to the knobs by means of straps, and to the loops by means of hooks, rings, rods, or cords. The orthopedic technic will not be considered here. I believe that this method will become more and more effective as the mechanism of artificial limbs becomes perfected.

The ordinary principles of flap making and shifting must be employed in covering the motor flaps with skin, and the loops in old stumps may be lined with pedunculated flaps sutured in the form of a tube with skin surface inward, much in the same way as in forming a urethra with a pedunculated flap from the scrotum. This skin-lined tube is then pulled through the channel prepared for it, or the muscle flaps are closed around it.

ELEPHANTIASIS

Etiology.—In the United States this condition is seldom met with as a result of obstruction of the lymph vessels by the *filaria bancrofti*. Matas believes that venous or lymphatic stasis followed by bacterial

invasion—usually streptococcic—is necessary to produce true elephantiasis, and gives the following conditions as essential in producing the picture: (1) A mechanical obstruction or blockage of the veins and lymphatics of the region, usually an obliterative thrombo-phlebitis, lymphangitis or adenitis; (2) hyperplasia of the collagenous connective tissue of the hypoderm; (3) gradual disappearance of the elastic fibers of the skin; (4) the existence of a coagulating dropsy or hard lymphedema; (5) a chronic reticular lymphangitis caused by secondary and repeated invasions of pathogenic microorganisms of the streptococcal type.

Treatment.—As the streptococcus is so closely associated with the etiology of elephantiasis, and as attacks of erysipelas so frequently occur, it is advisable to inject antistreptococcus serum or vaccine before and after operation, once or several times according to the indications. The toilet of the skin must be most carefully looked after, and all folds thoroughly disinfected. S. Handley, in 1908, introduced a method which he called “lymphangioplasty” and which he used to reduce the size of edematous arms, such as occur after the operations for the removal of the breast for carcinoma. The tissues of the arm are drained by two long “hairpin-shaped” lines of silk placed in the subcutaneous tissue, one on the flexor and one on the extensor surface. The bends of the “hairpins” lie immediately above the wrist, and the long portions of the threads are placed on each side, so that a thread is inserted at each quadrant. Toward the shoulder the lines of silk on the flexor side curve outward toward the deltoid muscle and converge with the threads from the posterior aspect at the posterior border of the deltoid. From this point the threads radiate into the subcutaneous tissue of the scapular region. The early results of this method were very encouraging when used in the arm or leg, but recurrence soon followed. The later results are unsatisfactory, and Madden, Ibrahim and Ferguson found that the threads were soon completely blocked off by scar tissue, and that in consequence all drainage from this source was obliterated.

Kondoléon in 1912, developed a method based on the good points of several other procedures, which is at once the most radical and the most promising for the relief of this condition. The modified technic, used at the Mayo Clinic and reported by **Sistrunk**, is the most satisfactory procedure for carrying out the method (Fig. 857-63).

The object of this operation is to allow the deeper group of lymphatics

exposed by the removal of the deep fascia to drain the tissue ordinarily taken care of by the blocked superficial group.

A long modified elliptic incision, which includes the skin to be removed, is made on one side of the limb. For example, on the outer aspect of the lower extremity this incision would extend from the

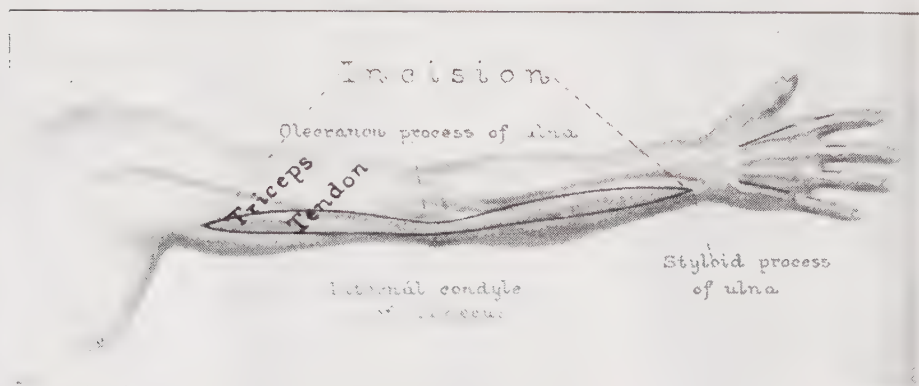


FIG. 857.

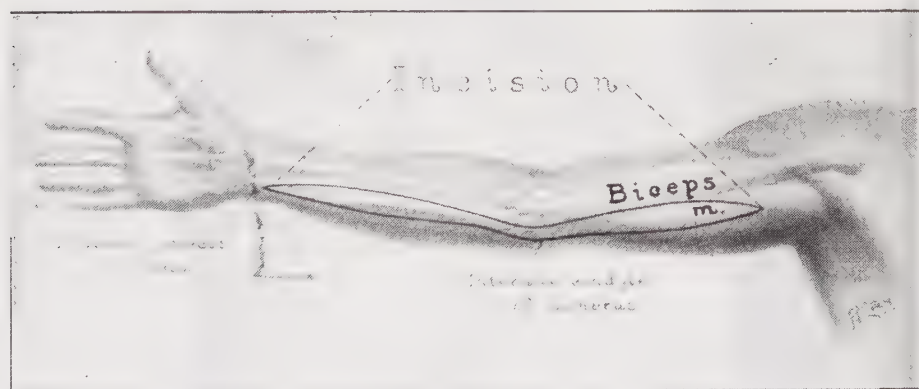


FIG. 858.

Kondol on's operation for elephantiasis (*Sistrunk*).

FIG. 857.—The dark lines indicate the incisions on the outer surface of the arm and forearm.

FIG. 858.—The dark lines indicate the incisions on the inner surface of the arm and forearm.

trochanter to the external malleolus. In order to facilitate the removal of the subcutaneous fat, the skin is undercut on each side of the incision for 2.5 or 5. cm. (1 or 2 inches). The edges are retracted and long parallel incisions are made through the edematous fat and deep aponeurosis. The ends of these incisions are connected by transverse

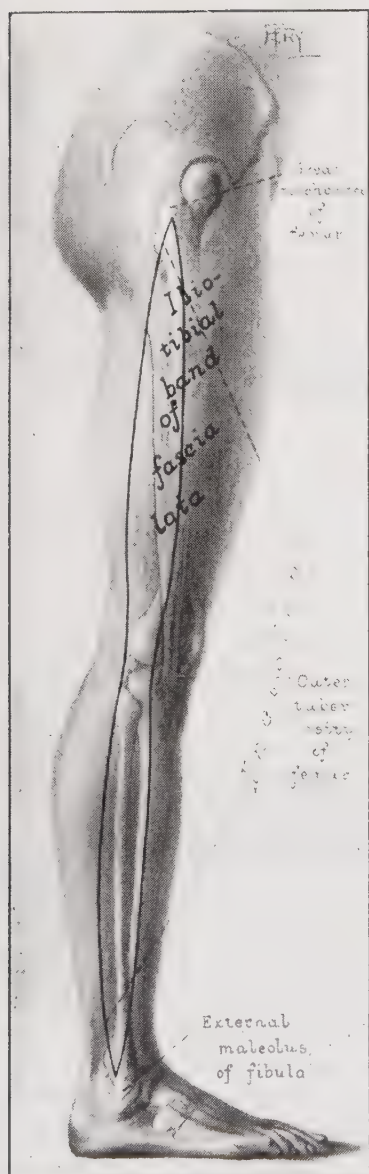


FIG. 859.

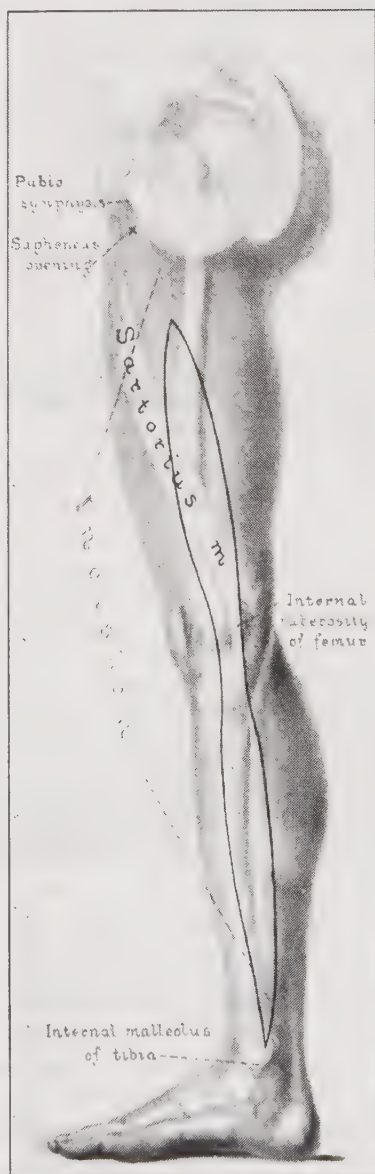


FIG. 860.

Kondoléon's operation for elephantiasis, *continued* (Sistrunk).

FIG. 859.—The dark lines indicate the incisions on the outer surface of the leg and thigh.

FIG. 860.—The dark lines indicate the incisions on the inner surface of the leg and thigh.

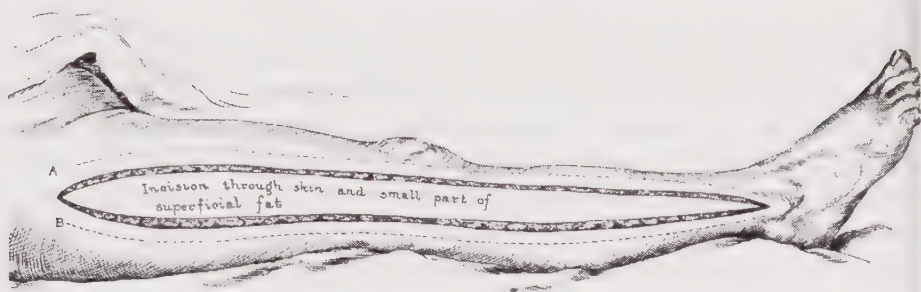


FIG. 861.—Kondoléon's operation, *continued*.—Incision through the skin and superficial portion of the subcutaneous fat used on outer surface of the leg and thigh. The dotted lines A and B show the extent to which the skin is undermined for the removal of the subcutaneous fat.

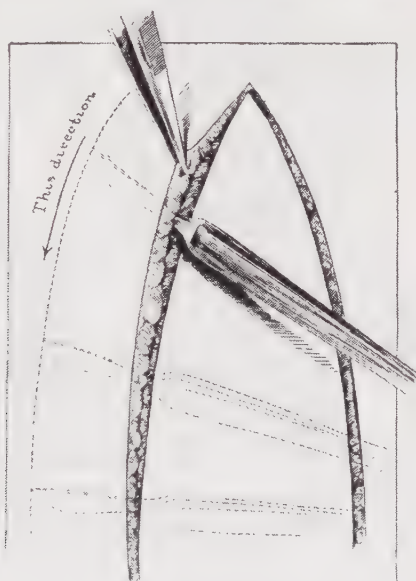


FIG. 862.

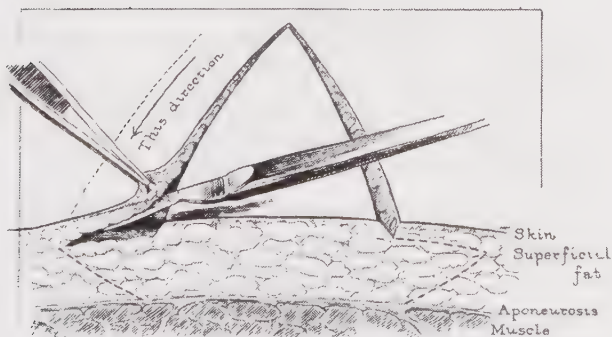


FIG. 863.

Kondoléon's operation for elephantiasis, *continued*.

FIG. 862.—Shows the method of undercutting used to remove a wide area of subcutaneous fat.

FIG. 863.—Cross section of Fig. 862. The dotted lines indicate the incisions made in removing the fat.

cuts. The mass of skin, fat and deep aponeurosis is then removed, leaving the muscles exposed. (If it is on the inside of the lower extremity the internal saphenous vein is tied off.) All bleeding is checked, and the wound is closed without drainage, so that the skin with a small amount of subcutaneous fat comes in contact with the exposed muscles. If the condition of the patient permits, the other side of the extremity is similarly treated immediately. If the condition does not warrant further work, the second operation is postponed until

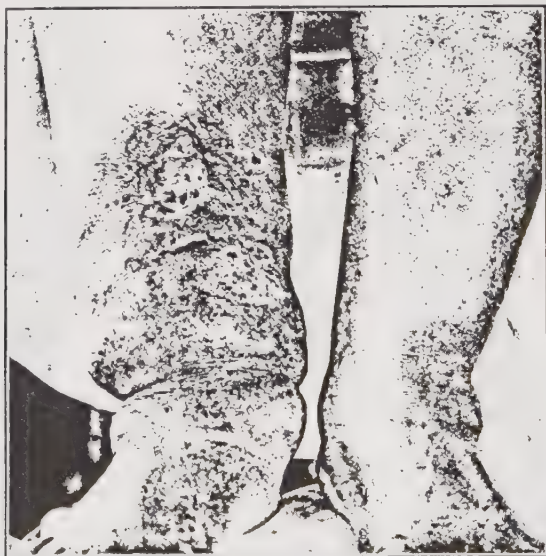


FIG. 864.—Elephantiasis of the right leg in a negress.—The etiology is obscure. The patient has had a leg ulcer off and on, but there is no history of erysipelas. No filaria could be found. The thigh was only slightly enlarged and its tissues were soft and apparently normal.

a suitable time. The patient is allowed to get up ten days after the operation, the part being supported with an elastic bandage.

The results in my own experience with Kondoléon's operation have been only fair. Possibly my excisions have not been quite so radical as those in the operation just described, and this may explain why I have not secured the hoped for results. In one of my cases, a girl of 22 years first noticed a swelling of the right leg and thigh when she was 17 years old. The etiology was absolutely obscure; nothing could be found in the history or by physical examination to account for the condition. During the operation on this case I had great difficulty in checking the lymph flow. The thigh wound would fill up with a straw-colored fluid which seemed to come from the entire raw

surface. Finally by using hot packs and pressure I was able to check the flow and the wound was closed. In the same case the subcutaneous fat was very rigid, and the deep fascia was opaque and much thickened, being 0.4 to 0.6 cm. (about $\frac{1}{6}$ to $\frac{1}{4}$ inch) thick in places.

Sometimes, when great folds of tissue hang down, it may be necessary to excise a portion of them in order to allow the patient to walk.

I saw Dr. Walton Martin operate on such a case at St. Luke's Hospital in New York. He removed a huge mass of tissue which enabled the woman to walk. This patient had previously had a similar operation with temporary relief, and it seemed probable that further operative work would be necessary.

Amputation has been done on several occasions for extensive elephantiasis (Wobus and Opie and others), but this should not be undertaken unless all other methods have proved useless.

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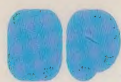
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